United States
Department of
Agriculture

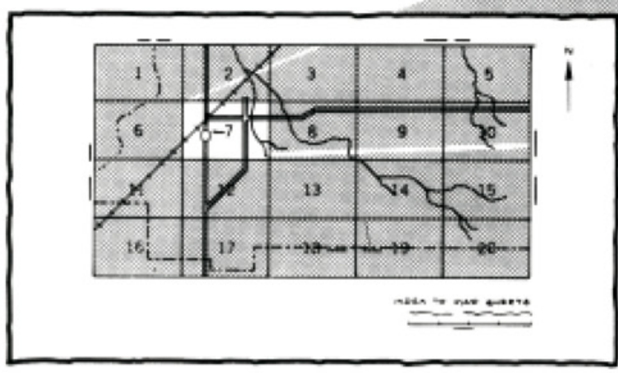
Soil
Conservation
Service

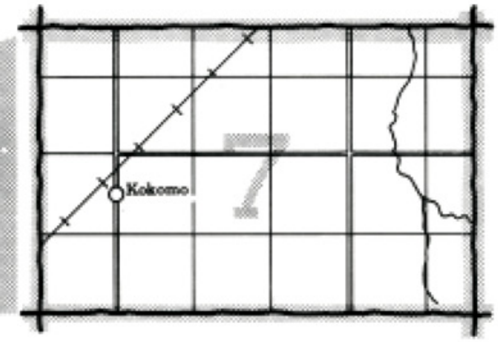
In cooperation with
North Dakota Agricultural
Experiment Station, North
Dakota Cooperative Extension
Service, and North Dakota
State Soil Conservation
Committee

Soil Survey of Grant County, North Dakota

HOW TO USE

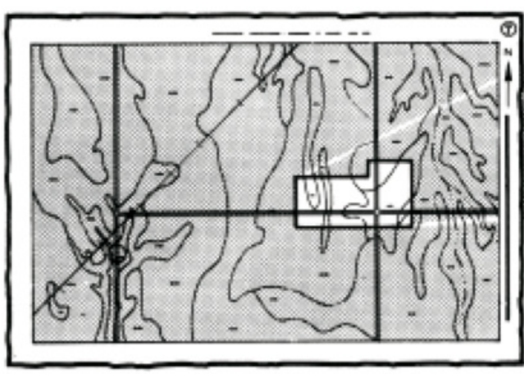
1. Locate your area of interest on the "Index to Map Sheets"

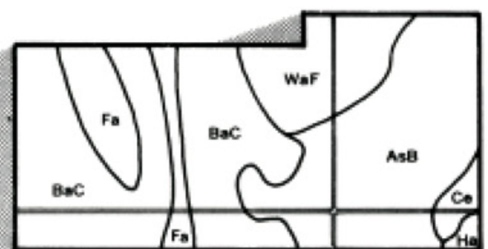




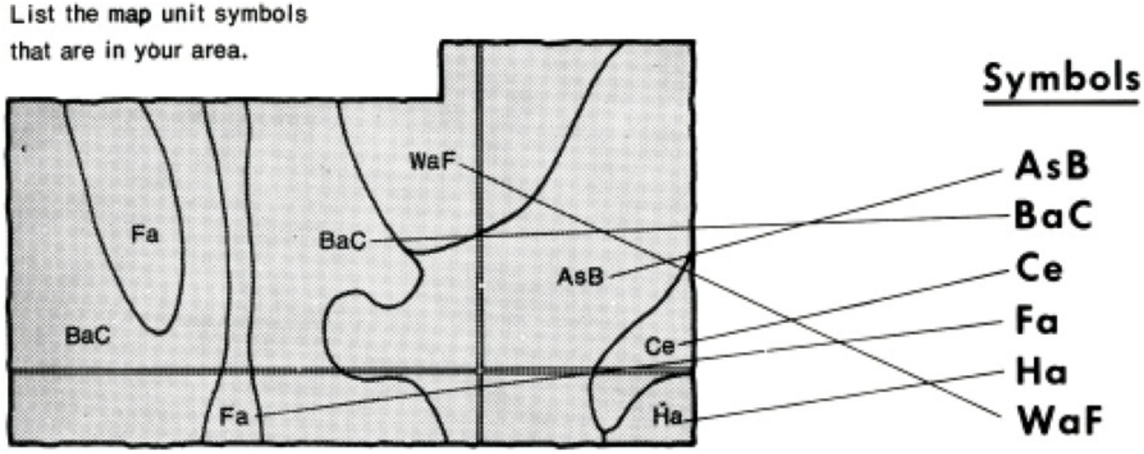
2. Note the number of the map sheet and turn to that sheet.

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



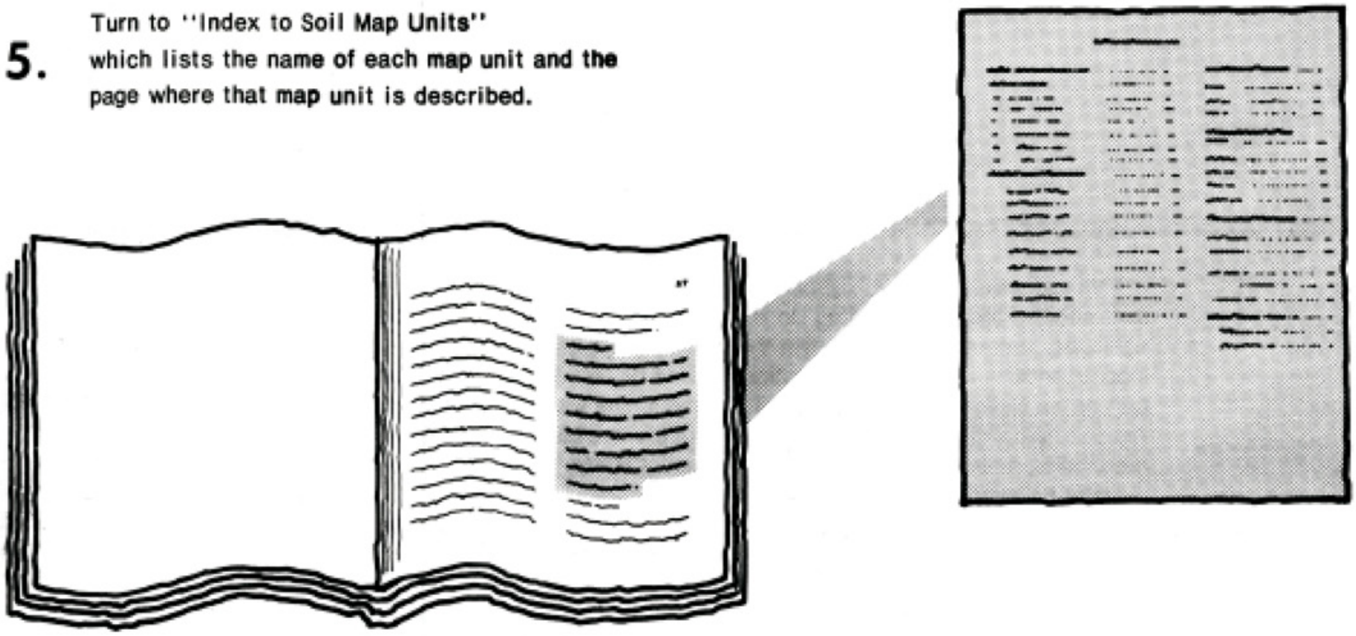


4. List the map unit symbols that are in your area.

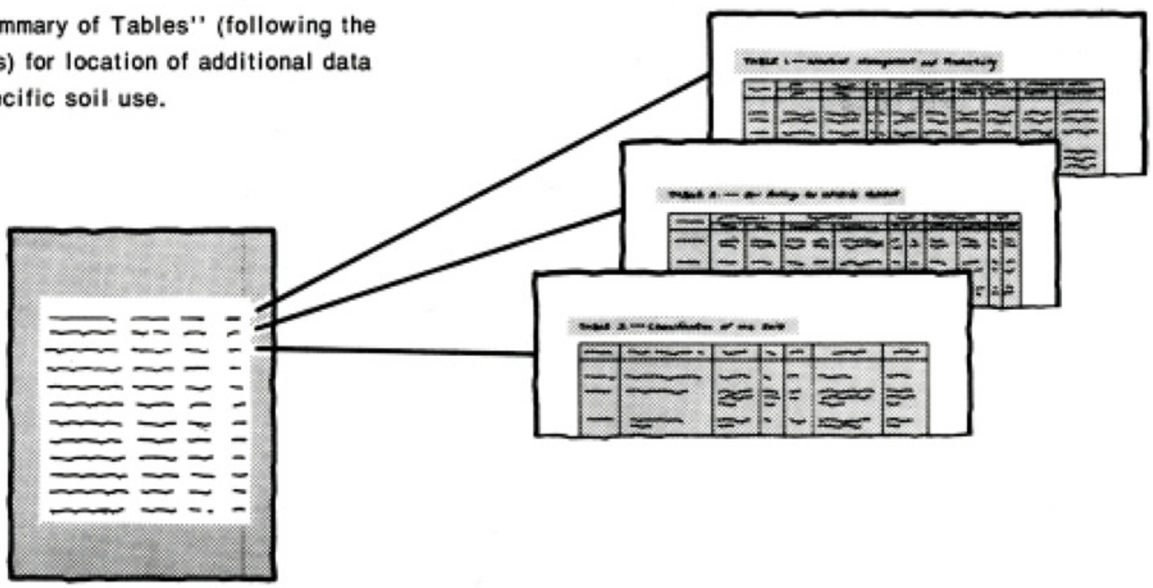


THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. 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, handicap, or age.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service, the North Dakota Agricultural Experiment Station, the North Dakota Cooperative Extension Service, and the North Dakota State Soil Conservation Committee. Financial assistance was provided by the Grant County Board of Commissioners and the Grant County Water Management Board. The survey is part of the technical assistance furnished to the Grant County Soil Conservation District.

Cover: An area of Straw and Velva soils used as cropland and hayland. Vebar and Flasher soils are in the background. Photo courtesy of the North Dakota State Soil Conservation Committee.

Contents

Soil Series

SEPTEMBER 1988

Index to Map Units

Summary of Tables

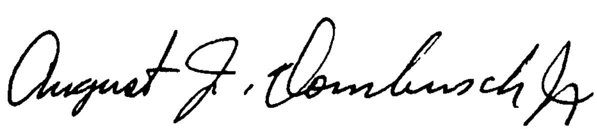
Foreword

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

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

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

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



August J. Dornbusch, Jr.
State Conservationist
Soil Conservation Service

Soil Survey of Grant County, North Dakota

By Lawrence E. Edland and Richard L. Lee, Soil Conservation Service

Fieldwork by Lawrence E. Edland, Richard L. Lee, and Dean K. Moos, Soil Conservation Service; Steven J. Tillotson and Ronald Luethe, State Soil Conservation Committee; and Paul K. Weiser, Francis W. Wilhelm, David V. Wroblewski, and Wesley M. Larsen, professional soil classifiers

Map finishing by David W. Hickcox, North Dakota State Soil Conservation Committee

United States Department of Agriculture, Soil Conservation Service, in cooperation with North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee

GRANT COUNTY is in the south-central part of North Dakota (fig. 1). It has an area of 1,070,080 acres, of which about 1,062,630 acres, or 1,666 square miles, is land and 7,450 acres is water. Most of the water is Lake Tschida. Carson, the county seat, is in the central part of the county.

The county is part of the Missouri Slope Vegetation Zone and the Rolling Soft Shale Plain land resource area of the North Great Plains (*18*). It is bounded on the north and east by Morton County, on the south by Sioux County, and on the west by Adams, Hettinger, and Stark Counties.

The major rivers are the Heart River, which crosses the northern part of the county from west to east, and the Cannonball River, which enters the county in the west-central part and joins with Cedar Creek in the southeastern part. Other major streams are Antelope Creek and Heart Butte Creek, in the northern part of the county; Louse Creek and Dog Tooth Creek, in the east-central part; and Sheep Creek and Snake Creek, in the south-central part (fig. 2).

The early geologic history of the survey area is one of repeated transgressions and regressions of seas, which deposited sediments within a subsiding basin. The more recent history is marked by the advancement of glaciers (*11*).

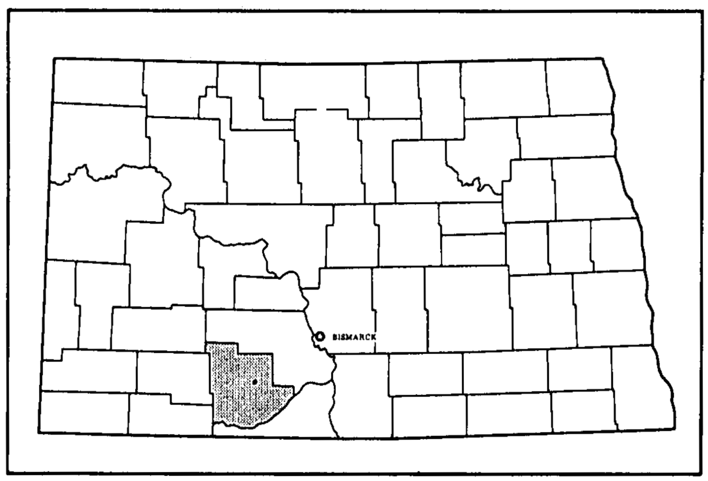


Figure 1.—Location of Grant County in North Dakota.

Elevation ranges from 1,800 feet above sea level in an area along the Cannonball River near Shields to 2,700

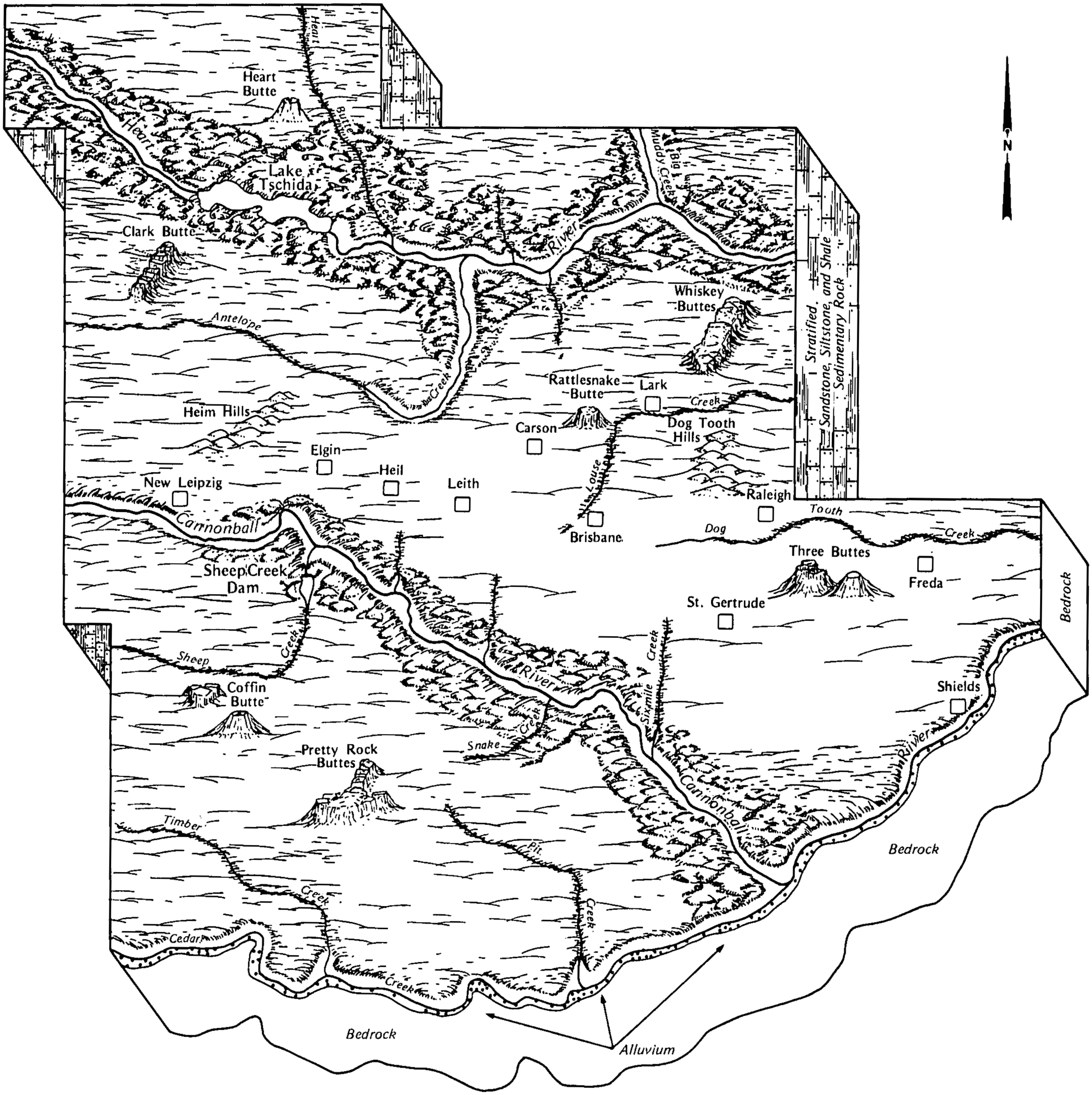


Figure 2.—The major streams and physiographic features of Grant County.

feet on the top of Coffin Butte, which is south of New Leipzig (*11*).

This soil survey updates the survey of Grant County published in 1910 (*10*). It provides additional information and larger maps, which show the soils in more detail.

General Nature of the County

This section provides general information about the settlement and history, natural resources, farming and ranching, and climate of Grant County.

Settlement and History

Indians living along the Missouri River hunted throughout the survey area, mainly along the Cannonball, Cedar, and Heart Rivers. They frequently stopped at a low butte southeast of Elgin known as Medicine Rock. To the west of the butte, a dance circle still survives. Also, there are rock carvings of deer tracks and of a turtle (*3*).

Among the earliest settlers were the cattle ranchers, who settled in the southeastern part of Grant County in the late 1890's. Small settlements with rural post offices preceded the advent of the railroads. General settlement began in the early 1900's. The Northern Pacific Railroad and the Chicago, Milwaukee and St. Paul Railroad were extended through the county in 1910. After the tracks were laid, many communities moved nearer the railroads.

Originally, the survey area was part of Morton County, which was established by the Territorial Legislature in 1873. At that time, several of the counties in south-central North Dakota were part of Morton County, the eastern boundary of which was the Missouri River. Grant County was separated from Morton County in 1916 (*3*).

The population of the county was 9,553 in 1920 and 10,134 in 1930, after which it began to decline. In 1980, it was 4,274. Carson has a population of 469, Elgin has one of 930, and New Leipzig has one of 354 (*11*).

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 by livestock. The major aquifers are the Fox Hills, Hell Creek, Cannonball and Ludlow, and Tongue River aquifers. The water is suitable for livestock, domestic, and limited industrial uses but generally is not suitable for irrigation because it has a high content of sodium. Most of the water used as domestic and livestock water on farms is derived from veins in the Fort Union Formation. Water from the Heart Butte Reservoir (Lake Tschida) is used to irrigate land in the Heart River Irrigation District. About 38 irrigators irrigate 4,700 acres in the county. Water from other streams in the county is of limited value, except as water for livestock, because the seasonal flow is low.

Small reserves of lignite coal are located in the western part of the county. One commercial mining company operates in the county. Most of the coal is used locally for heating homes and businesses.

A few areas of sand, gravel, and porcellanite (scoria) have been mined in the county. This material is used mainly for surfacing secondary roads (*11*).

Farming and Ranching

Most of the farms in Grant County are diversified. They derive income from cow-calf operations for beef or dairies and from small grain crops. A few farmers grow mainly small grain and sunflowers. The cattle ranches are mainly along the Heart, Cannonball, and Cedar Rivers. The ranchers raise oats and barley for feed and grasses and legumes for forage.

According to the local office of the North Dakota Cooperative Extension Service, the number of farms in the county increased from the time of settlement until the 1930's, when the depression and prolonged drought forced many landowners to give up their farms. The number of farms has continued to decrease since its peak of 1,511 in 1930. It was 744 in 1978. In 1930, the rural population began to decrease from a high of 8,656 and is continuing to decline. The average size of farms and ranches was about 624 acres in 1930, 920 acres in 1950, 1,196 acres in 1964, and 1,260 acres in 1978. Generally, the livestock ranches are considerably larger than the diversified farms.

About 645,000 acres, or 60 percent of the land area, is used as range. The rest is mostly cropland. The major crop is hard red spring wheat, which yields an average of 19 bushels per acre per year. Other commonly grown cash crops are barley, flax, and sunflowers. Crops that are primarily fed to livestock are oats, corn cut for silage, alfalfa, tame grasses, and sweetclover.

Three townships and parts of six others, all in the southeastern part of the county, were organized as part of the Cedar Soil Conservation District in 1938. The Grant County Soil Conservation District was organized in 1947. The areas in the Cedar Soil Conservation District were included in the Grant County Soil Conservation District in 1961.

Climate

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

Grant County is usually quite warm in summer, which is characterized by frequent spells of hot weather and occasional cool days. The county is very cold in winter, when artic air frequently surges over the area. Most precipitation falls during the warm period and is normally heaviest in late spring and early summer. Winter snowfall is normally not too heavy, and it is blown into drifts, so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Carson in the period 1951 to 1980. 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 13 degrees F, and the average daily minimum temperature is 3 degrees. The lowest temperature on record, which occurred at Carson on January 29, 1966, is -41 degrees. In summer the average temperature is 67 degrees, and the average daily maximum temperature is 80 degrees. The highest recorded temperature, which occurred at Carson on August 10, 1958, is 106 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (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.

The total annual precipitation is about 17 inches. Of this, about 14 inches, or more than 80 percent, usually falls in April through September. The growing season for most crops falls within this period. 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 3.60 inches at Carson on June 9, 1964. Thunderstorms occur on about 44 days each year. During some of the summer thunderstorms, hail falls in scattered small areas.

The average seasonal snowfall is about 29 inches. The greatest snow depth at any one time during the period of record was 24 inches. On the average, 40 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. Blizzards occur several times each winter.

The average relative humidity in midafternoon is about 45 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the east-southeast. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures used to make this survey are described in the Soil Conservation Service's National Soils Handbook and the *Soil Survey Manual* (*14*). *The Major Soils of North Dakota* (*12*) and a description of the ground water resources of Grant County (*13*) were among the references used.

As they mapped the soils, soil scientists traversed the landscape on foot, by pickup, or by three-wheel, all-terrain cycles at an interval close enough to locate contrasting soil areas of about 5 acres. All map units were characterized by transects of representative areas. One transect was required for each 1,000 acres of the unit mapped. A minimum of 2 and a maximum of about 10 transects were made for each map unit. Data collected from the transects were used to identify the kinds of soil and establish the range of composition of each map unit. The transect data were analyzed by a statistical method explained by R.W. Arnold (*4*). This analysis indicates that the map unit composition given in the map unit descriptions is at least 90 percent accurate.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Laboratory data were collected in 1981 and 1982 on 18 pedons sampled for engineering properties. The analyses were made by the North Dakota State Highway Department. The North Dakota State University, Soil Characterization Laboratory, also analyzed 10 of the pedons for engineering properties. An additional 15 pedons were sampled for specific soil laboratory information during the course of the soil survey.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

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

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect 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 general soil map of Grant County do not match exactly with those on the general soil maps of Adams and Hettinger Counties.

Soil Descriptions

Moderately Deep, Shallow, and Deep, Medium Textured and Moderately Fine Textured Soils on Uplands

These soils formed in material weathered from shale, siltstone, and sandstone and in alluvium. They make up about 45 percent of the county. Most areas are used for cultivated crops; however, some areas are used as range. The soils are suited to cultivated crops and well suited to range. The main concerns in managing cultivated areas are controlling water erosion and conserving moisture. The main concerns in managing range are achieving a uniform distribution of grazing and maintaining an adequate cover of the important forage plants.

1. Regent-Rhoades-Moreau Association

Moderately deep and deep, well drained and moderately well drained, moderately fine textured and medium textured, nearly level to moderately sloping soils formed in material weathered from soft shale and in alluvium

This association consists of nearly level to moderately sloping soils on foot slopes and side slopes in the uplands. The landscape is dotted with low knolls. Most areas are drained by shallow, intermittent streams. Slope ranges from 1 to 9 percent.

This association makes up about 6 percent of the county. It is about 25 percent Regent and similar soils, 20 percent Rhoades soils, 10 percent Moreau soils, and 45 percent soils of minor extent.

The gently sloping and moderately sloping Regent soils are on the mid and lower side slopes. They are lower on the landscape than the Moreau soils and higher than the Rhoades soils. Typically, they have a silty clay loam surface layer about 6 inches thick. The subsoil is silty clay and silty clay loam about 30 inches thick. Below this is soft shale bedrock.

The nearly level to moderately sloping Rhoades soils are on the lower side slopes and on foot slopes. They are lower on the landscape than the Moreau and Regent soils. Typically, they have a loam surface layer about 3 inches thick. The subsurface layer is silt loam about 2 inches thick. The subsoil is silty clay and silty clay loam about 28 inches thick. The substratum to a depth of about 60 inches is clay.

The gently sloping and moderately sloping Moreau soils are on low knolls and the upper side slopes. They are higher on the landscape than the Regent and Rhoades soils. Typically, they have a clay loam surface layer about 5 inches thick. The subsoil is silty clay about 7 inches thick. The substratum is silty clay about 9 inches thick. Below this is shale bedrock.

Arnegard, Grail, Shambo, and Vebar are some of the minor soils in this association. The nonalkali, nearly level and gently sloping Arnegard and nearly level Grail soils are deep. They are in swales. The nearly level and gently sloping Shambo soils have a loam surface layer, subsoil, and substratum. They are on alluvial fans. The gently sloping to strongly sloping Vebar soils have a fine sandy loam surface layer and subsoil. They are on side slopes.

Most of this association is used for cultivated crops; however, the steeper soils generally are used as range. The association is well suited to range and is suited to cultivated crops, hay, and pasture. The hazard of soil blowing is moderate, and the hazard of water erosion is severe. Droughtiness, a high runoff rate, the content of sodium salts in the Rhoades and Moreau soils, and a limited rooting depth are the main limitations affecting agricultural uses. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock.

2. Chama-Cabba-Sen Association

Moderately deep and shallow, well drained, medium textured, gently sloping to very steep soils formed in material weathered from soft siltstone

This association consists of gently sloping to very steep soils on side slopes, ridges, and hills in the uplands. Most areas are drained by intermittent streams. Slope ranges from 3 to 45 percent.

This association makes up about 3 percent of the county. It is about 30 percent Chama soils, 25 percent Cabba soils, 10 percent Sen soils, and 35 percent soils of minor extent.

The moderately sloping and strongly sloping Chama soils are on the mid and upper side slopes. They are lower on the landscape than the Cabba soils and higher than the Sen soils. Typically, they have a silt loam surface layer about 6 inches thick. The subsoil is silt loam about 8 inches thick. The substratum is silt loam about 20 inches thick. Below this is siltstone bedrock.

The gently sloping to very steep Cabba soils are on ridges and hills. They are higher on the landscape than the Chama and Sen soils. Typically, they have a silt loam surface layer about 3 inches thick. The next 3 inches also is silt loam. The substratum is silt loam about 4 inches thick. Below this is siltstone bedrock.

The gently sloping Sen soils are on the lower and mid side slopes. They are lower on the landscape than the Cabba and Chama soils. They have a silt loam surface layer about 6 inches thick. The subsoil is silt loam about 20 inches thick. The substratum is silt loam about 7 inches thick. Below this is soft siltstone bedrock.

Daglum, Grail, Moreau, Regent, and Rhoades are the minor soils in this association. The nearly level to moderately sloping Daglum and Rhoades soils have a dense, alkali subsoil. They are on the lower side slopes and foot slopes. The nearly level Grail soils are deep. They are in swales. The gently sloping and moderately sloping Moreau soils have a clay loam surface layer and a silty clay and silty clay loam subsoil. They are on low knolls and the upper side slopes. The gently sloping and moderately sloping Regent soils have a silty clay loam surface layer and a silty clay and silty clay loam subsoil. They are on the mid and lower side slopes.

This association is used about equally for cultivated crops and range. It is well suited to range and is suited to cultivated crops, hay, and pasture. The hazards of soil blowing and water erosion are severe. Droughtiness, the slope, and a limited rooting depth are the main limitations affecting agricultural uses. Sparse stands of native trees and shrubs are along a few drainageways. They provide food for wildlife and cover for wildlife and livestock.

3. Amor-Regent-Cabba Association

Moderately deep and shallow, well drained, medium textured and moderately fine textured, gently sloping to very steep soils formed in material weathered from shale, siltstone, and sandstone

This association consists of gently sloping to very steep soils on side slopes, hills, and ridges in the uplands. Most areas are drained by intermittent streams. Slope ranges from 3 to 45 percent.

This association makes up about 36 percent of the county. It is about 35 percent Amor and similar soils, 10 percent Regent and similar soils, 10 percent Cabba soils, and 45 percent soils of minor extent (fig. 3).

The gently sloping to strongly sloping Amor soils are on the upper and mid side slopes. They are lower on the landscape than the Cabba soils and higher than the Regent soils. Typically, they have a loam surface layer about 6 inches thick. The subsoil is loam about 31 inches thick. Below this is sandstone bedrock.

The gently sloping and moderately sloping Regent soils are on the mid and lower side slopes. They are lower on the landscape than the Amor and Cabba soils. Typically, they have a silty clay loam surface layer about 6 inches thick. The subsoil is silty clay and silty clay loam about 30 inches thick. Below this is soft shale bedrock.

The gently sloping to very steep Cabba soils are on ridges and hills. They are higher on the landscape than the Amor and Regent soils. Typically, they have a loam surface layer about 3 inches thick. The next layer is silt loam about 3 inches thick. The substratum is silt loam about 4 inches thick. Below this is soft siltstone bedrock.

Arnegard, Daglum, and Grail are some of the minor soils in this association. The nearly level and gently sloping Arnegard and nearly level Grail soils are deep. They are in swales. The nearly level and gently sloping Daglum soils have a dense, alkali subsoil. They are on foot slopes.

Most of this association is used for cultivated crops; however, the steeper soils generally are used as range. The association is suited to cultivated crops, hay, and pasture and is well suited to range. The hazard of water erosion is severe. Also, the hazard of soil blowing is moderate on the Cabba soils. Droughtiness, a high runoff rate, and a limited rooting depth are the main limitations affecting agricultural uses. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock.

Deep and Moderately Deep, Moderately Coarse Textured and Medium Textured Soils on Terraces and Uplands

These soils formed in alluvium and material weathered from sandstone, shale, and siltstone. They make up about 9 percent of the county. Most areas are used as

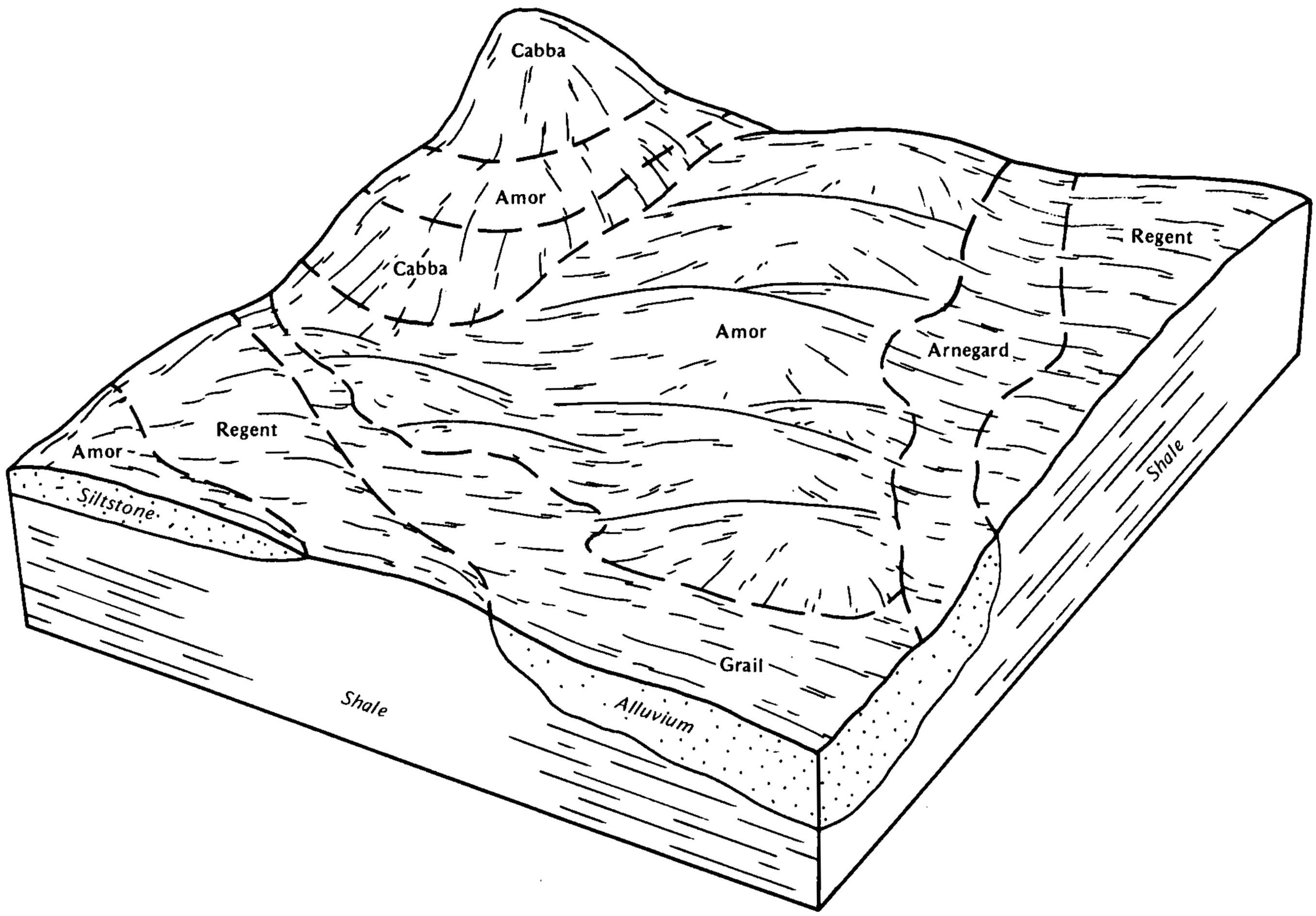


Figure 3.—Typical pattern of soils and parent material in the Amor-Regent-Cabba association.

range. The soils are suited to range but are poorly suited to cultivated crops. The main concerns in managing range are achieving a uniform distribution of grazing and maintaining an adequate cover of the important forage plants. The main concerns in managing cultivated areas are the content of sodium salts, a restricted rooting depth, and a moderate or low available water capacity.

4. Ekalaka-Desart-Lemert Association

Deep, moderately well drained and well drained, moderately coarse textured, nearly level to moderately sloping, alkali soils formed in alluvium or material weathered from sandstone

This association consists of nearly level to moderately sloping soils on terraces and on side slopes and foot slopes in the uplands. Most areas are drained by many shallow, intermittent streams. Slope ranges from 1 to 9 percent.

This association makes up about 3 percent of the county. It is about 35 percent Ekalaka soils, 20 percent Desart soils, 15 percent Lemert soils, and 30 percent soils of minor extent (fig. 4).

The nearly level to moderately sloping Ekalaka soils are on the upper and mid foot slopes in the uplands and on terraces. They are lower on the landscape than the Desart soils and higher than the Lemert soils. Typically, they have a fine sandy loam surface layer about 6 inches thick. The subsurface layer also is fine sandy loam about 6 inches thick. The subsoil is fine sandy loam and loamy fine sand about 13 inches thick. The substratum to a depth of about 60 inches is fine sandy loam.

The nearly level and gently sloping Desart soils are on the mid and lower foot slopes in the uplands and on terraces. They are higher on the landscape than the Ekalaka and Lemert soils. Typically, they have a fine sandy loam and very fine sandy loam surface soil about 17 inches thick. The subsurface layer is very fine sandy

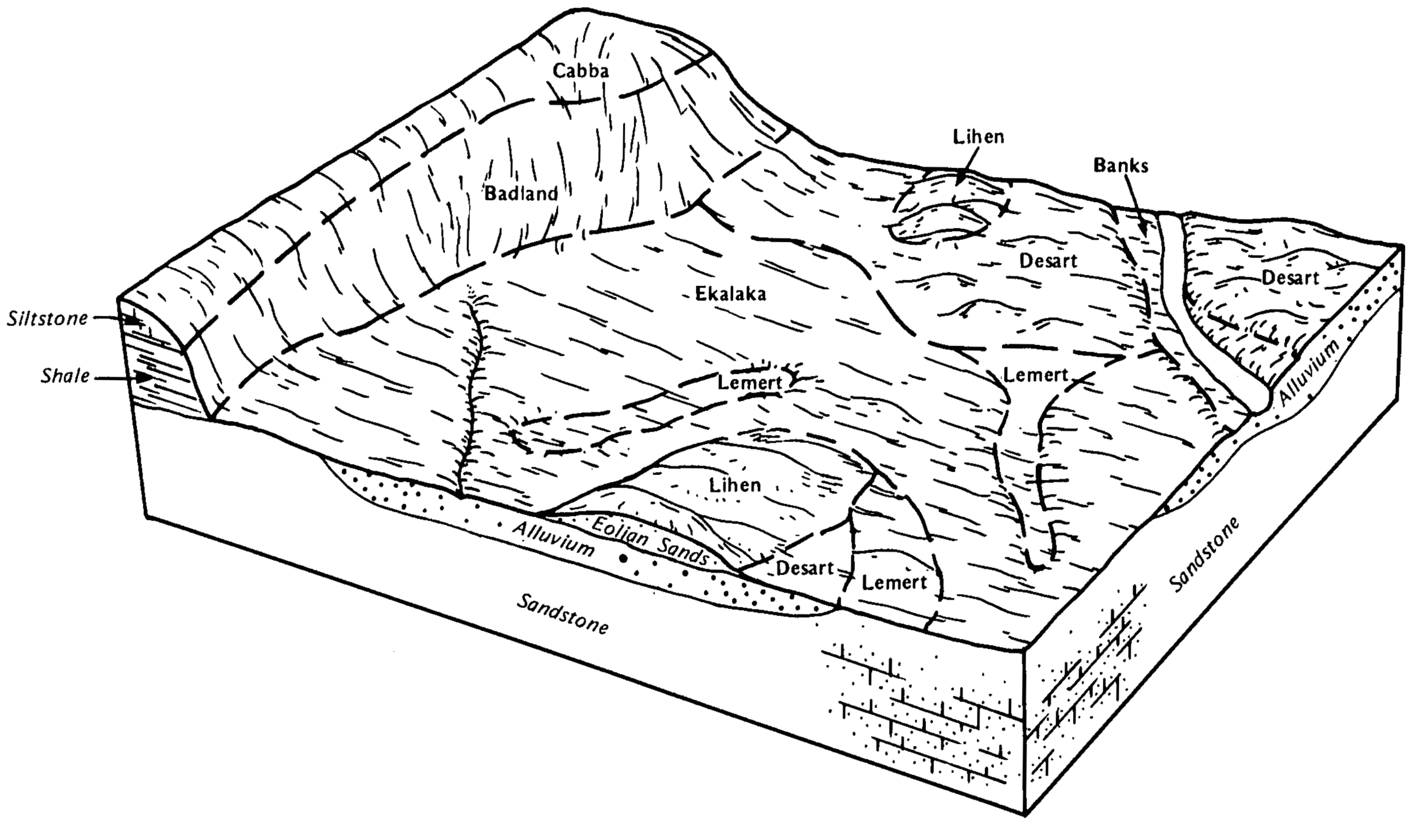


Figure 4.—Typical pattern of soils and parent material in the Ekalaka-Desart-Lemert association.

loam about 8 inches thick. The subsoil is very fine sandy loam and loam about 13 inches thick. The substratum is loamy fine sand about 10 inches thick. Below this is sandstone bedrock.

The nearly level Lemert soils are on foot slopes in the uplands and on terraces. They are lower on the landscape than the Desart and Ekalaka soils. Typically, they have a fine sandy loam surface layer about 2 inches thick. The subsurface layer is fine sandy loam about 3 inches thick. The subsoil is fine sandy loam and loamy fine sand about 19 inches thick. The substratum to a depth of about 60 inches is loamy fine sand and fine sandy loam.

Banks, Cabba, Flasher, Lihen, Parshall, and Vebar are the minor soils in this association. Badland also is of minor extent. It occurs as barren, eroded areas of exposed soft bedrock. The somewhat excessively drained Banks soils are on flood plains. The shallow, loamy Cabba soils are on summits and shoulder slopes on hills and ridges. The shallow, sandy Flasher soils are on hills and ridges. The sandy Lihen and loamy Parshall soils do not have a dense, alkali subsoil. They are in swales. Vebar soils are moderately deep. They are on side slopes.

This association is used mainly for range. It is well suited to range, is suited to hay and pasture, and is poorly suited to cultivated crops. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. The content of sodium salts, a restricted rooting depth, the hazard of soil blowing, and droughtiness are the main limitations affecting agricultural uses.

5. Rhoades-Daglum-Amor Association

Deep and moderately deep, moderately well drained and well drained, medium textured, nearly level to strongly sloping, dominantly alkali soils formed in alluvium and material weathered from soft shale, siltstone, or sandstone

This association consists of nearly level to strongly sloping soils on foot slopes and side slopes in the uplands. Most areas are drained by shallow, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 6 percent of the county. It is about 25 percent Rhoades soils, 20 percent Daglum soils, 15 percent Amor and similar soils, and 40 percent soils of minor extent.

The nearly level to moderately sloping Rhoades soils are on the lower side slopes and foot slopes. They are lower on the landscape than the Amor soils and occur as areas intermingled with areas of the Daglum soils. Typically, they have a loam surface layer about 3 inches thick. The subsurface layer is silt loam about 2 inches thick. The subsoil is silty clay and silty clay loam about 28 inches thick. The substratum to a depth of about 60 inches is clay.

The nearly level to moderately sloping Daglum soils are on foot slopes. They are lower on the landscape than the Amor soils and occur as areas intermingled with areas of the Rhoades soils. Typically, they have a loam surface layer about 7 inches thick. The subsurface layer is loam about 3 inches thick. The subsoil is clay and clay loam about 10 inches thick. The substratum to a depth of about 60 inches is clay loam and silty clay loam.

The gently sloping to strongly sloping Amor soils are on the upper and mid side slopes. They are higher on the landscape than the Daglum and Rhoades soils. Typically, they have a loam surface layer about 6 inches thick. The subsoil is loam about 31 inches thick. Below this is sandstone bedrock.

Cabba, Flasher, and Vebar are the minor soils in this association. The strongly sloping to very steep Cabba and Flasher soils are shallow. They are on hills and ridges. The gently sloping to strongly sloping Vebar soils have a fine sandy loam surface layer and subsoil. They are on side slopes.

This association is used mainly for range. It is suited to range, hay, and pasture and but is poorly suited to cultivated crops. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. The content of sodium salts, a restricted rooting depth, and droughtiness are the main limitations affecting agricultural uses.

Moderately Deep, Deep, and Shallow, Moderately Coarse Textured and Coarse Textured Soils on Uplands

These soils formed in alluvium and material weathered from sandstone. They make up about 33 percent of the county. Most areas are used for range or cultivated crops. The soils are suited to cultivated crops and range. The main concerns in managing range are achieving a uniform distribution of grazing, maintaining an adequate cover of the important forage plants, and controlling soil blowing. The main concerns in managing cultivated areas are controlling soil blowing and water erosion and conserving moisture.

6. Flasher-Vebar-Parshall Association

Shallow, moderately deep, and deep, somewhat excessively drained and well drained, coarse textured and moderately coarse textured, nearly level to very steep soils formed in material weathered from sandstone or in alluvium

This association consists of nearly level to very steep soils on side slopes, foot slopes, toe slopes, hills, and ridges in the uplands. Most areas are drained by entrenched, intermittent streams. Slope ranges from 1 to 45 percent.

This association makes up about 13 percent of the county. It is about 45 percent Flasher soils, 30 percent Vebar soils, 10 percent Parshall and similar soils, and 15 percent soils of minor extent.

The moderately sloping to very steep Flasher soils are on ridges and hills. They are higher on the landscape than the Vebar and Parshall soils. Typically, they have a loamy fine sand surface layer about 6 inches thick. The substratum is loamy fine sand about 4 inches thick. Below this is sandstone bedrock.

The nearly level to strongly sloping Vebar soils are on side slopes. They are lower on the landscape than the Flasher soils and higher than the Parshall soils. Typically, they have a fine sandy loam surface layer about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. The substratum is sandy loam about 7 inches thick. Below this is sandstone bedrock.

The nearly level and gently sloping Parshall soils are on foot slopes and toe slopes. They are lower on the landscape than the Flasher and Vebar soils. Typically, they have a fine sandy loam surface layer about 9 inches thick. The subsoil is fine sandy loam about 24 inches thick. The substratum to a depth of about 60 inches is sandy loam and fine sandy loam.

Amor, Arnegard, Daglum, and Grail are the minor soils in this association. The gently sloping to strongly sloping Amor soils have a loam surface layer and subsoil. They are on side slopes. The nearly level and gently sloping Arnegard and nearly level Grail soils are in swales. Arnegard soils have a loam surface layer. Grail soils have a silty clay loam surface layer. The nearly level and gently sloping Daglum soils have a dense, alkali subsoil. They are on foot slopes.

Most of this association is used for range; however, some areas of the nearly level and gently sloping soils are used for cultivated crops. The association is well suited to range. The less sloping areas of the Vebar and Parshall soils are suited to cultivated crops, hay, and pasture. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. Droughtiness, a limited rooting depth, and the depth to bedrock are the main limitations affecting agricultural uses. Sparse stands of native trees and shrubs are along drainageways. They provide food for wildlife and cover for wildlife and livestock.

7. Vebar-Parshall-Beisigl Association

Moderately deep and deep, well drained and somewhat excessively drained, moderately coarse textured and coarse textured, nearly level to strongly sloping soils formed in material weathered from sandstone or in alluvium

This association consists of nearly level to strongly sloping soils on side slopes, foot slopes, and toe slopes in the uplands. The landscape is dotted with low knolls. Most areas are drained by entrenched, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 20 percent of the county. It is about 35 percent Vebar soils, 20 percent Parshall and similar soils, 5 percent Beisigl and similar soils, and 40 percent soils of minor extent (fig. 5).

The nearly level to strongly sloping Vebar soils are on the mid and lower side slopes. They are higher on the landscape than the Parshall soils and lower than the Beisigl soils. Typically, they have a fine sandy loam surface layer about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. The substratum is sandy loam about 7 inches thick. Below this is sandstone bedrock.

The nearly level and gently sloping Parshall soils are on foot slopes and toe slopes. They are lower on the landscape than the Beisigl and Vebar soils. Typically, they have a fine sandy loam surface layer about 9 inches thick. The subsoil is fine sandy loam about 24 inches thick. The substratum to a depth of about 60 inches is fine sandy loam and sandy loam.

The nearly level to strongly sloping Beisigl soils are on the mid and upper side slopes and on low knolls. They are higher on the landscape than the Parshall and Vebar soils. Typically, they have a loamy fine sand surface layer about 6 inches thick. The subsoil is loamy fine sand and fine sand about 15 inches thick. Below this is sandstone bedrock.

Amor, Arnegard, Daglum, Flasher, and Grail are some of the minor soils in this association. The gently sloping to strongly sloping Amor soils have a loam surface layer and subsoil. They are on side slopes. The nearly level and gently sloping, deep Arnegard soils have a loam surface layer. They are in swales. The nearly level and gently sloping Daglum soils have a dense, alkali subsoil. They are on foot slopes. The strongly sloping to very steep Flasher soils are shallow. They are on ridges and

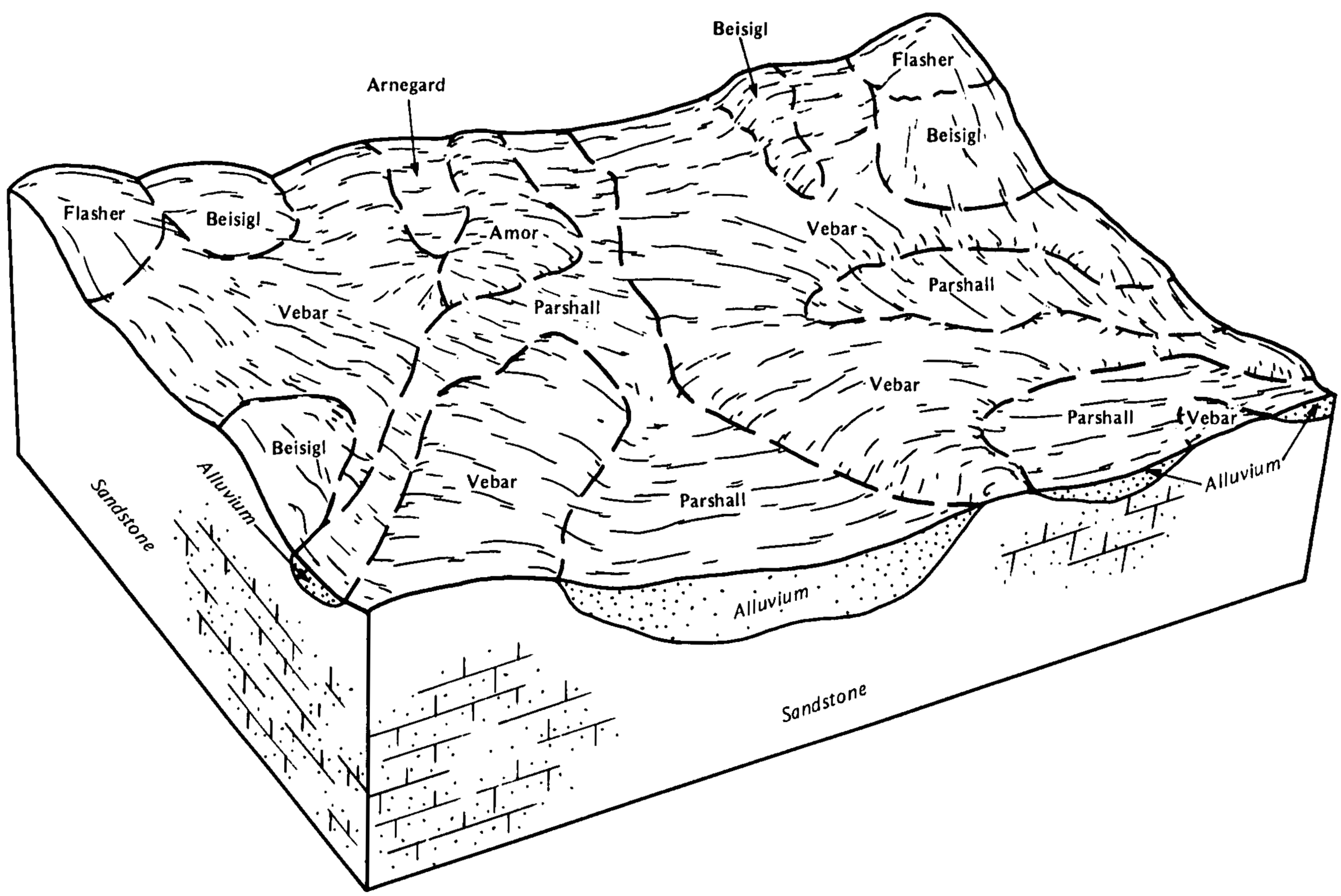


Figure 5.—Typical pattern of soils and parent material in the Vebar-Parshall-Beisigl association.

hills. The nearly level, deep Grail soils have a silty clay loam surface layer. They are in swales.

Most of this association is used for cultivated crops; however, the steeper soils generally are used as range. The association is well suited to range. It is generally suited to cultivated crops, but the Beisigl soils are poorly suited. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. Soil blowing and drought are the main hazards affecting agricultural uses. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock.

Deep, Coarse Textured Soils on Uplands

These soils formed in alluvium or eolian sediments. They make up about 2 percent of the county. Most areas are used as range. The soils are suited to range but are poorly suited to cultivated crops. The principal concerns in managing range are achieving a uniform distribution of grazing, controlling soil blowing, and maintaining an adequate cover of the important forage plants. The main concerns in managing cultivated areas are soil blowing and droughtiness.

8. Telfer-Lihen-Seroco Association

Deep, excessively drained and well drained, coarse textured, nearly level to strongly sloping soils formed in alluvium and eolian sediments

This association consists of nearly level to strongly sloping soils on side slopes, ridgetops, knobs, and ridges in the uplands. The landscape is dotted with swales. Most areas are drained by shallow, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 2 percent of the county. It is about 25 percent Telfer soils, 20 percent Lihen soils, and 15 percent Seroco and similar soils, and 40 percent soils of minor extent (fig. 6).

The nearly level to moderately sloping Telfer soils are on side slopes. They are higher on the landscape than the Lihen soils and lower than the Seroco soils. Typically, they have a loamy fine sand surface layer about 5 inches thick. The next layer is loamy sand about 6 inches thick. The substratum to a depth of about 60 inches is loamy sand and fine sand.

The nearly level and gently sloping Lihen soils are on the lower side slopes and in swales. They are lower on the landscape than the Telfer and Seroco soils. Typically, they have a loamy fine sand surface soil about 14 inches thick. The next layer is loamy fine sand about 13 inches thick. The substratum to a depth of about 60 inches is loamy sand.

The nearly level to strongly sloping Seroco soils are on ridges and knobs. They are higher on the landscape than the Lihen and Telfer soils. Typically, they have a

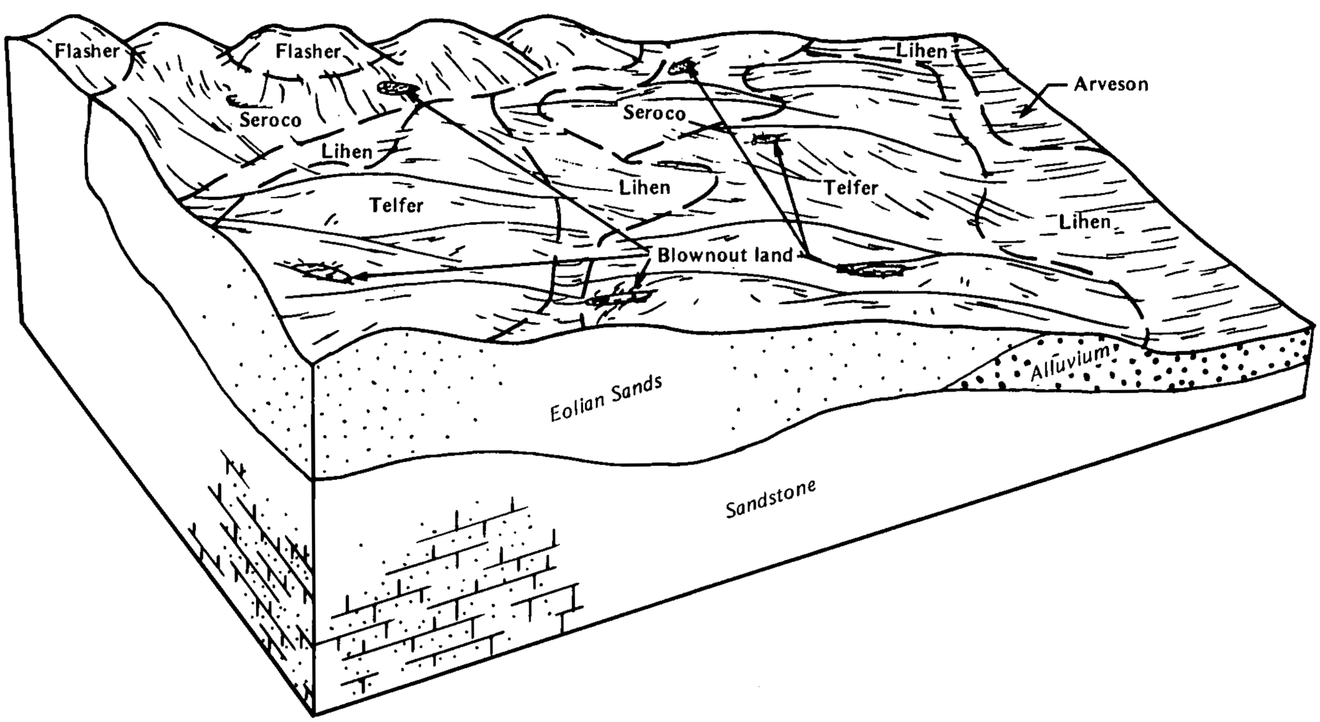


Figure 6.—Typical pattern of soils and parent material in the Telfer-Lihen-Seroco association.

loamy fine sand surface layer about 7 inches thick. The substratum to a depth of about 60 inches is loamy sand and loamy fine sand.

Arveson, Beisigl, Ekalaka, Flasher, and Vebar are the minor soils in this association. Blownout land also is of minor extent. The level Arveson soils are poorly drained. They are in swales and depressions. The moderately sloping to strongly sloping Beisigl soils are moderately deep. They are on side slopes. The nearly level to moderately sloping Ekalaka soils have a dense, alkali subsoil. They are on foot slopes. The moderately sloping to very steep Flasher soils are shallow. They are on hills and ridges. The gently sloping to strongly sloping Vebar soils are moderately deep. They are on side slopes.

This association is used mainly for range. It is well suited to range and to hay and pasture. The Lihen soils are poorly suited to cultivated crops, and the Telfer and Seroco soils are unsuited. The hazard of soil blowing is severe. Soil blowing and drought are the principal hazards affecting agricultural uses. Sparse stands of native trees and shrubs are in the swales. They provide food and cover for wildlife and livestock.

Deep and Moderately Deep, Medium Textured and Moderately Fine Textured Soils on Uplands

These soils formed in alluvium and material weathered from siltstone and sandstone. They make up about 3 percent of the county. Most areas are used as cropland, but the steeper soils generally are used as range. The soils are well suited to cultivated crops and range. The main concerns in managing cultivated areas are maintaining tilth and controlling erosion. The principal concerns in managing range are achieving a uniform distribution of grazing and maintaining an adequate cover of the important forage plants.

9. Shambo-Grail-Amor Association

Deep and moderately deep, well drained, medium textured and moderately fine textured, nearly level to strongly sloping soils formed in alluvium and material weathered from siltstone and sandstone

This association consists of nearly level to strongly sloping soils on foot slopes, alluvial fans, and side slopes in the uplands. Most areas are dissected by shallow, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 3 percent of the county. It is about 40 percent Shambo soils, 30 percent Grail soils, 15 percent Amor soils, and 15 percent soils of minor extent.

The nearly level and gently sloping Shambo soils are on alluvial fans. They are lower on the landscape than the Amor soils and higher than the Grail soils. Typically, they have a loam surface soil about 13 inches thick. The subsoil is loam about 29 inches thick. The substratum to a depth of about 60 inches is loam.

The nearly level Grail soils are on foot slopes. They are lower on the landscape than the Amor and Shambo soils. Typically, they have a silty clay loam surface layer about 8 inches thick. The subsoil is clay, silty clay loam, and silty clay about 28 inches thick. The substratum to a depth of about 60 inches is loam and clay loam.

The gently sloping to strongly sloping Amor soils are on side slopes. They are higher on the landscape than the Grail and Shambo soils. Typically, they have a loam surface layer about 6 inches thick. The subsoil is loam about 31 inches thick. Below this is sandstone bedrock.

Cabba, Daglum, Flasher, and Heil are the minor soils in this association. The moderately sloping to very steep Cabba soils are shallow. They are on hills and ridges. The nearly level and moderately sloping Daglum soils have a dense, alkali subsoil. They are on foot slopes. The moderately sloping to very steep Flasher soils are shallow. They are on hills and ridges. The poorly drained Heil soils have a dense, alkali subsoil. They are in depressions.

Most of this association is used for cultivated crops; however, the steeper soils generally are used as range. The association is well suited to cultivated crops, hay, pasture, and range. Soil blowing is a slight hazard and water erosion a moderate hazard. The main concerns in managing the soils for agricultural uses are maintaining tilth and controlling water erosion. Sparse stands of native trees and shrubs are along some drainageways. They provide food and cover for wildlife and livestock.

Deep, Moderately Coarse Textured and Medium Textured Soils on Terraces and Flood Plains

These soils formed in alluvium. They make up about 8 percent of the county. Most areas are used for cultivated crops; however, some areas are used for hay, pasture, or range. The soils are suited to cultivated crops and well suited to range. The main concerns in managing cultivated areas and hayland are maintaining tilth and controlling erosion. The main concerns in managing pasture and range are achieving a uniform distribution of grazing and maintaining an adequate cover of the key range or introduced plants.

10. Banks-Breien-Ruso Association

Deep, somewhat excessively drained and well drained, moderately coarse textured and medium textured, level to gently sloping soils formed in alluvium

This association consists of level to gently sloping soils on flood plains and terraces. Slope ranges from 0 to 6 percent.

This association makes up about 1 percent of the county. It is about 30 percent Banks soils, 20 percent Breien soils, 10 percent Ruso and similar soils, and 40 percent soils of minor extent.

The level Banks soils are on levees on flood plains. Typically, they have a loam surface layer about 4 inches thick. The substratum to a depth of about 60 inches is sand.

The level Breien soils are on flood plains and terraces. Typically, the surface soil is fine sandy loam about 15 inches thick. It is stratified with loam in the lower part. The next layer is loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is fine sand.

The nearly level and gently sloping Ruso soils are on terraces. Typically, they have a fine sandy loam surface layer about 5 inches thick. The subsoil is fine sandy loam about 19 inches thick. The next layer is loamy sand about 5 inches thick. The substratum to a depth of about 60 inches is gravelly loamy coarse sand and fine sand.

Cabba, Ekalaka, and Schaller are some of the minor soils in this association. The strongly sloping to very steep Cabba soils are shallow. They are on knolls and escarpments. The nearly level to moderately sloping Ekalaka soils have a dense, alkali subsoil. They are on terraces. The gently sloping to very steep Schaller soils have a fine sandy loam surface layer and a loamy coarse sand substratum. They are on terraces and escarpments.

This association is used about equally for cultivated crops and for hay, pasture, or range. It is well suited to range, pasture, and hay and is suited to cultivated crops. The hazard of soil blowing is severe and the hazard of water erosion is slight. Flooding and soil blowing are the main hazards affecting agricultural uses. In most areas stands of native trees and shrubs are along the stream channels. They provide food and cover for wildlife and livestock.

11. Straw-Velva-Bowdle Association

Deep, well drained, medium textured and moderately coarse textured, level and nearly level soils formed in alluvium

This association consists of level and nearly level soils on flood plains and terraces. Most areas are dissected by shallow, intermittent drainageways that are perpendicular to the streams. Slope ranges from 0 to 3 percent.

This association makes up about 5 percent of the county. It is about 40 percent Straw soils, 15 percent Velva soils, 10 percent Bowdle soils, and 35 percent soils of minor extent.

The level and nearly level Straw soils are on flood plains. Typically, they have a loam and clay loam surface soil about 27 inches thick. The substratum to a depth of about 60 inches is loam and clay loam.

The level and nearly level Velva soils are on flood plains and terraces. Typically, they have a fine sandy loam surface layer about 6 inches thick. The substratum to a depth of about 60 inches is fine sandy loam, sandy loam, and loam.

The nearly level Bowdle soils are on terraces. Typically, they have a loam surface layer about 8 inches thick. The subsoil is loam and sandy loam about 20 inches thick. The substratum to a depth of about 60 inches is very gravelly sand and gravelly sand.

Banks, Cabba, Flasher, Parshall, Schaller, Shambo, and Vebar are the minor soils in this association. Banks soils have a loam surface layer and a sand substratum. They are on levees. The strongly sloping to very steep Cabba soils are shallow. They are on escarpments and stream valley walls. Flasher soils are shallow. They are on knolls. The nearly level and gently sloping Parshall soils have a fine sandy loam surface layer. They are on terraces. The gently sloping to very steep Schaller soils have a fine sandy loam surface layer and a loamy coarse sand substratum. They are on terrace escarpments. The nearly level and gently sloping Shambo soils have a loam surface layer and subsoil. They are on alluvial fans and terraces. The gently sloping to strongly sloping Vebar soils have a fine sandy loam surface layer and subsoil. They are on valley side slopes.

Most of this association is used for cultivated crops; however, some areas are used for hay, pasture, or range. The association is well suited to cultivated crops, hay, pasture, and range. Flooding and soil blowing are the main hazards affecting agricultural uses. In most areas stands of native trees and shrubs are along the stream channels. They provide food and cover for wildlife.

12. Ruso-Straw-Bowdle Association

Deep, well drained, medium textured and moderately coarse textured, level to gently sloping soils formed in alluvium

This association consists of level to gently sloping soils on terraces and flood plains. Most areas are dissected by intermittent drainageways that are perpendicular to the streams. Slope ranges from 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 40 percent Ruso and similar soils, 25 percent Straw soils, 10 percent Bowdle soils, and 25 percent soils of minor extent (fig. 7).

The nearly level and gently sloping Ruso soils are on terraces. Typically, they have a fine sandy loam surface layer about 5 inches thick. The subsoil is fine sandy loam about 19 inches thick. The next layer is loamy sand about 5 inches thick. The substratum to a depth of about 60 inches is gravelly loamy coarse sand and fine sand.

The level and nearly level Straw soils are on flood plains. Typically, they have a loam and clay loam surface soil about 27 inches thick. The substratum to a depth of about 60 inches is loam and clay loam.

The nearly level Bowdle soils are on terraces. Typically, they have a loam surface layer about 8 inches thick. The subsoil is loam and sandy loam about 20

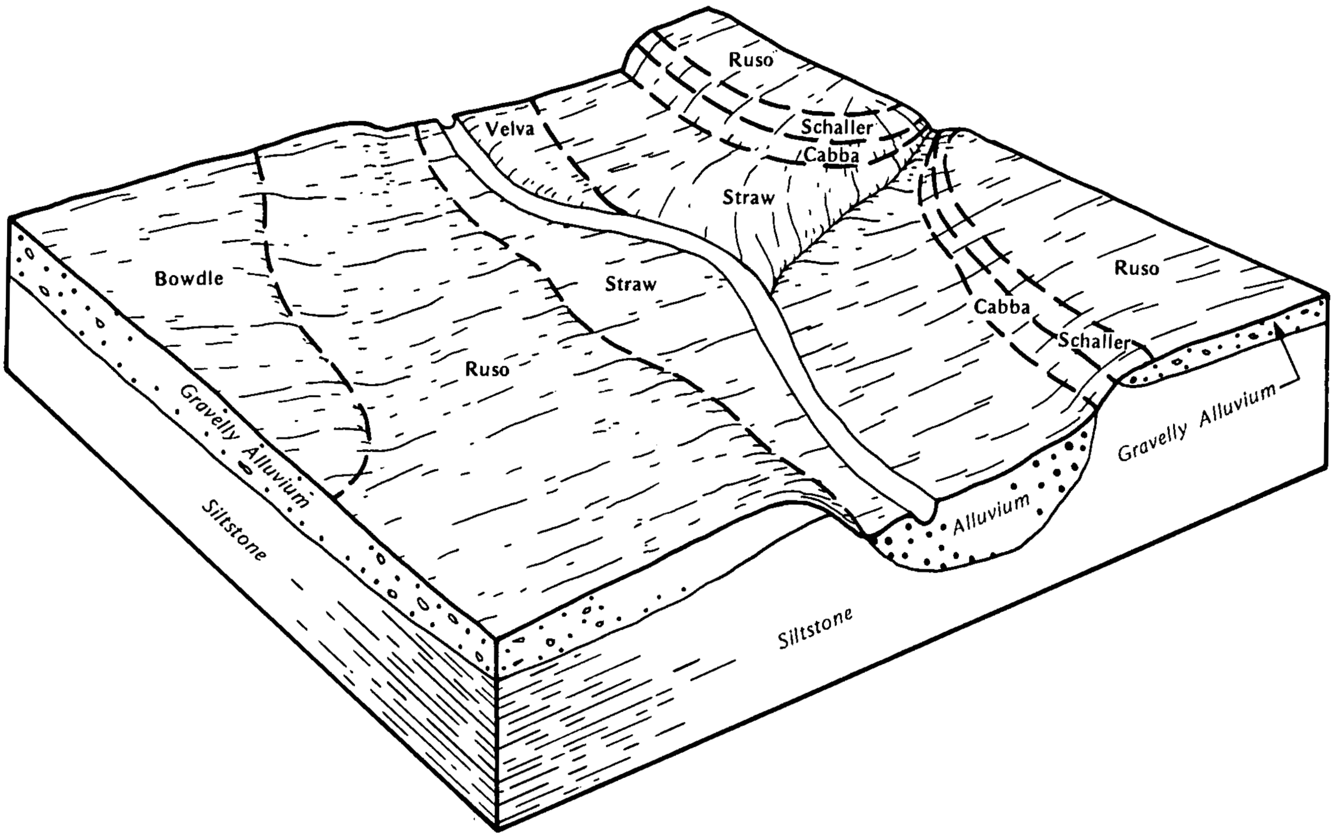


Figure 7.—Typical pattern of soils and parent material in the Ruso-Straw-Bowdle association.

inches thick. The substratum to a depth of about 60 inches is very gravelly sand and gravelly sand.

Banks, Cabba, Flasher, Rhoades, Schaller, and Velva are the minor soils in this association. The level Banks soils have a sand substratum. They are on levees. The strongly sloping to very steep Cabba soils are shallow. They are on ridges, escarpments, and valley walls. The moderately sloping to very steep Flasher soils are shallow. They are on knolls. The nearly level to moderately sloping Rhoades soils have a dense, alkali subsoil. They are on foot slopes. The gently sloping to very steep Schaller soils have a fine sandy loam surface layer and a loamy coarse sand substratum. They are on terrace escarpments. The well drained Velva soils have a fine sandy loam substratum. They are on flood plains.

This association is used about equally for cultivated crops and for hay, pasture, or range. It is well suited to these uses. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Soil blowing and flooding are the main hazards affecting agricultural uses. In most areas stands of native trees and shrubs are along the stream channels. They provide food and cover for wildlife and livestock.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Amor loam, 3 to 6 percent slopes, is a phase in the Amor series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Amor-Cabba loams, 9 to 15 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Dumps and pits, mine, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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 detailed soil maps of Grant County do not match exactly with those on the maps of Adams and Hettinger Counties.

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

Soil Descriptions

1B—Amor loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is loam about 31 inches thick. It is brown in the upper part, light olive brown in the next part, and grayish brown in the lower part. Below this is soft sandstone bedrock. In some places the soil is silty clay loam or fine sandy loam throughout. In other places, the surface layer is sandy loam and the subsoil is sandy clay loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Cabba, Daglum, and Grail soils. These soils make up about 10 percent of the unit. Cabba soils have soft bedrock at a depth of 10 to 20 inches. They are on knobs and ridges. Daglum soils have an alkali subsoil. They are on toe slopes. Grail soils are deep and are dark to a depth of more than 16 inches. They are in swales.

Permeability and available water capacity are moderate in the Amor soil. Runoff is medium. Root penetration is restricted by the soft bedrock at a depth of about 37 inches. The surface layer is friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Controlling erosion and maintaining tilth are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass, blue grama, and needleandthread. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 71.

1C—Amor loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is loam about 31 inches thick. It is brown in the upper part, light olive brown in the next part, and grayish brown in the lower part. Below this is soft sandstone bedrock. In some places the soil is silty clay loam or fine sandy loam throughout. In other places, the subsoil contains more clay and the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Cabba, Daglum, and Flasher soils. These soils make up about 5 to 20 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Cabba and Flasher soils have soft bedrock within a depth of 20 inches. They are on hills and ridges. Daglum soils have an alkali subsoil. They are on foot slopes.

Permeability and available water capacity are moderate in the Amor soil. Runoff is medium. Root penetration is restricted by the soft bedrock at a depth of about 37 inches. The surface layer is friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops, but some are used for hay, pasture, or range. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a severe hazard. Controlling erosion and maintaining tilth are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass, blue grama, and needleandthread. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIIe. The range site is Silty. The productivity index for spring wheat is 51.

3D—Amor-Cabba loams, 3 to 15 percent slopes, very stony. These gently sloping to strongly sloping, well drained soils are on uplands. The moderately deep Amor soil is on side slopes, and the shallow Cabba soil is on hills and ridges. About 10 percent of the surface is covered with stones and boulders. Individual areas are irregular in shape and range from 10 to more than 50 acres in size. They are about 45 to 50 percent Amor soil and 45 to 50 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Amor soil has a dark brown loam surface layer about 6 inches thick. The subsoil is loam about 31 inches thick. It is brown in the upper part, light olive brown in the next part, and grayish brown in the lower part. Below this is soft sandstone bedrock. In some places the soil is fine sandy loam throughout. In other places the depth to bedrock is more than 40 inches. In some areas the soil is silty clay loam throughout.

Typically, the Cabba soil has a grayish brown loam surface layer about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In places the soil is silty clay or fine sandy loam throughout.

Included with these soils in mapping are small areas of Arnegard and Rhoades soils. These included soils make up about 10 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are on foot slopes. Rhoades soils have an alkali subsoil. They are on foot slopes and toe slopes.

Permeability is moderate in the Amor and Cabba soils, and runoff is rapid. Available water capacity is moderate in the Amor soil and very low in the Cabba soil. Root penetration is restricted by the soft bedrock at a depth of about 37 inches in the Amor soil and 15 inches in the Cabba soil.

Most areas are used as range. These soils generally are unsuited to cultivated crops, grasses and legumes for pasture and hay, and windbreaks and environmental plantings because of the limited depth to bedrock and the stoniness. Soil blowing is a slight hazard and water erosion a severe hazard.

The important range forage plants on these soils are western wheatgrass, blue grama, and needleandthread. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock also is a limitation, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for waste disposal. In the steeper areas, the slope is a limitation on sites for septic tank absorption fields and buildings, but designing the buildings and absorption fields so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification is VIs. The range site of the Amor soil is Silty, and that of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 0.

5D—Amor-Cabba loams, 9 to 15 percent slopes. These strongly sloping, well drained soils are on uplands that generally are dissected by many small drainageways. The moderately deep Amor soil is on side slopes, and the shallow Cabba soil is on hills and ridges. Individual areas are irregular in shape and range from 10 to more than 50 acres in size. They are about 50 to 65 percent Amor soil and 30 to 45 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Amor soil has a dark brown loam surface layer about 6 inches thick. The subsoil is loam about 31 inches thick. It is brown in the upper part, light olive brown in the next part, and grayish brown in the lower part. Below this is soft sandstone bedrock. In some places the soil is fine sandy loam throughout. In other places, the subsoil contains more clay and the surface layer is silty clay loam.

Typically, the Cabba soil has a grayish brown loam surface layer about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In places the soil is silty clay or fine sandy loam throughout. In a few areas the surface layer is 8 to 12 inches thick.

Included with these soils in mapping are small areas of Arnegard and Rhoades soils. These included soils make up about 5 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are on foot slopes. Rhoades soils have an alkali subsoil. They are on foot slopes and side slopes.

Permeability is moderate in the Amor and Cabba soils, and runoff is rapid. Available water capacity is moderate in the Amor soil and very low in the Cabba soil. Root penetration is restricted by the soft bedrock at a depth of about 37 inches in the Amor soil and 10 inches in the Cabba soil. The surface layer of both soils is friable and can be easily tilled. Tilth is good.

Most areas are used for range, hay, or pasture, but a few areas are used for cultivated crops. These soils are suited to pasture and hay but are poorly suited to corn, flax, and small grain because of the slope and the erosion hazard. Soil blowing is a moderate hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, needleandthread, blue grama, and little bluestem. Crested wheatgrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Amor soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock also is a limitation, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for absorption fields. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the buildings and absorption fields so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification of the Amor soil is IVe, and that of the Cabba soil is VIe. The range site of the Amor soil is Silty, and that of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 26.

6—Arnegard loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on foot slopes in the uplands. Individual areas are irregular in shape and range from 5 to more than 50 acres in size.

Typically, the surface soil is loam about 18 inches thick. It is dark grayish brown in the upper part and very dark grayish brown in the lower part. The subsoil is loam about 29 inches thick. It is dark grayish brown in the upper part, brown in the next part, and light olive brown in the lower part. Below this to a depth of about 60 inches is light yellowish brown loam. In some places the soil is fine sandy loam throughout. In other places, the surface layer is silty clay loam and the subsoil is silty clay.

Included with this soil in mapping are small areas of Daglum soils. These soils make up about 5 to 15 percent of the unit. They have an alkali subsoil. They occur as areas intermingled with areas of the Arnegard soil.

Permeability is moderate in the Arnegard soil, and runoff is slow. Available water capacity is high. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for hay or pasture. Soil blowing and water erosion are slight hazards. Maintaining tilth and the content of organic matter is the main management concern if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife and helps to maintain or increase the content of organic matter. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

The important range forage plants on this soil are big bluestem, western wheatgrass, and green needlegrass. Smooth bromegrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but enlarging the field helps to overcome this limitation.

The land capability classification is IIc. The range site is Overflow. The productivity index for spring wheat is 96.

6B—Arnegard loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface soil is loam about 18 inches thick. It is dark grayish brown in the upper part and very dark grayish brown in the lower part. The subsoil is loam about 29 inches thick. It is dark grayish brown in the upper part, brown in the next part, and light olive brown in the lower part. Below this to a depth of about 60 inches is light yellowish brown loam. In some places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In other places, the surface layer is silty clay loam and the subsoil is silty clay.

Included with this soil in mapping are small areas of Amor and Daglum soils. These soils make up about 5 to 15 percent of the unit. Amor soils have soft bedrock at a depth of 20 to 40 inches. Daglum soils have an alkali subsoil. They occur as areas intermingled with areas of the Arnegard soil.

Permeability is moderate in the Arnegard soil, and runoff is medium. Available water capacity is high. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, helps to maintain tilth, and increases the rate of water infiltration.

The important range forage plants on this soil are needleandthread, western wheatgrass, and green needlegrass. Smooth bromegrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but enlarging the field helps to overcome this limitation.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 83.

7—Banks loam. This deep, level, somewhat excessively drained soil is on levees on flood plains. It is frequently flooded. Individual areas are long and narrow and range from 20 to more than 50 acres in size.

Typically, the surface layer is grayish brown loam about 4 inches thick. The substratum to a depth of about 60 inches is grayish brown sand. In places the surface layer is fine sandy loam 6 to 10 inches thick.

Included with this soil in mapping are small areas of Straw and Velva soils and riverwash. These areas make up about 5 percent of the unit. Riverwash generally lacks vegetation and is adjacent to the stream channels. Straw and Velva soils are generally in the areas more distant from the stream channels. Straw soils have a clay loam and loam substratum. Velva soils have a fine sandy loam surface layer.

Permeability is rapid in the Banks soil, and runoff is slow. Available water capacity is low.

Most areas are used for range and wildlife habitat. This soil generally is unsuited to corn, flax, and small grain and to grasses and legumes for pasture and hay because of soil blowing, droughtiness, and flooding. Soil blowing is a severe hazard and water erosion a slight hazard.

The important range forage plants on this soil are prairie sandreed and needleandthread. Intermediate and pubescent wheatgrass, prairie sandreed, and sweetclover are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Some areas support a stand of native trees and shrubs, such as eastern cottonwood, willow, green ash, wild rose, and common chokecherry.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Sites that are not subject to flooding generally are nearby.

The land capability classification is VIe. The range site is Sands. The productivity index for spring wheat is 0.

8—Breien fine sandy loam. This deep, level, somewhat excessively drained soil is on terraces and flood plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to more than 100 acres in size.

Typically, the surface soil is fine sandy loam about 15 inches thick. It is dark grayish brown in the upper part, dark brown in the middle part, and dark grayish brown in the lower part. The next layer is light brownish gray loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is light brownish gray fine sand. In some places the soil is fine sandy loam throughout. In other places the surface layer is loam.

Included with this soil in mapping are small areas of Desart, Ekalaka, and Straw soils. These soils make up about 5 to 15 percent of the unit. Desart and Ekalaka soils are on foot slopes. Desart soils have an alkali subsoil at a depth of 20 to 40 inches, and Ekalaka soils have one at a depth of 9 to 20 inches. Straw soils contain less sand than the Breien soil. Also, they are farther from the stream channels.

Permeability is moderately rapid in the Breien soil, and runoff is slow. Available water capacity is low. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for hay, pasture, or range. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a slight hazard. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and diversions help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are prairie sandreed and needleandthread. Smooth bromegrass, prairie sandreed, and alfalfa are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Sites that are not subject to flooding generally are nearby.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 41.

9—Bowdle loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces. It is underlain by sand and gravel at a depth of about 28 inches. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark grayish brown loam in the upper part and light brownish gray sandy loam in the lower part. The upper part of the substratum is multicolored very gravelly sand. The lower part to a depth of about 60 inches is grayish brown gravelly sand. In some places the soil contains more sand in the upper part. In other places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In a few areas the depth to sand and gravel is more than 40 or less than 20 inches.

Included with this soil in mapping are small areas of Arnegard, Daglum, Grail, and Shambo soils. These soils make up about 5 to 25 percent of the unit. Arnegard and Shambo soils have a nongravelly substratum. Arnegard soils are dark to a depth of more than 16 inches. Daglum soils have an alkali subsoil. Grail soils contain more clay than the Bowdle soil. Arnegard, Daglum, and Grail soils are in swales.

Permeability is moderate in the upper part of the Bowdle soil and rapid in the lower part. Runoff is slow. Available water capacity is moderate. Root penetration is restricted by the sand and gravel at a depth of about 28 inches. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining tilth, overcoming droughtiness, and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage and grassed waterways also help to provide food and cover for resident and migratory upland wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. Rye and winter wheat can make the best use of early season moisture. Leaving tall stubble on the surface helps to trap snow and thus increases the moisture supply.

The important range forage plants on this soil are needleandthread, blue grama, and western wheatgrass. Smooth bromegrass, green needlegrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the surface against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and moisture stress commonly affects trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the moderate available water capacity.

No critical limitations affect the use of this soil as a site for buildings. Because of the rapid permeability, the soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored.

The land capability classification is IIIs. The range site is Silty. The productivity index for spring wheat is 60.

10F—Cabba loam, 15 to 45 percent slopes. This shallow, moderately steep to very steep, well drained soil is on ridges and hills on uplands that generally are dissected by many intermittent drainageways. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In a few places the surface layer is 8 to 12 inches thick. In some areas the soil is silty clay, fine sandy loam, or loamy fine sand throughout. In other areas the depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are small areas of Arnegard, Daglum, Grail, and Harriet soils. These soils make up about 10 percent of the unit. Arnegard, Daglum, and Grail soils are deep. They are in swales. Daglum and Harriet soils have an alkali subsoil. Harriet soils are in drainageways.

Permeability is moderate in the Cabba soil, and runoff is very rapid. Available water capacity is very low. Root penetration is restricted by the soft bedrock at a depth of about 10 inches.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of the slope, droughtiness, and the hazard of water erosion. Soil blowing is a moderate hazard and water erosion a severe hazard.

The important range forage plants on this soil are little bluestem and needleandthread. Soil blowing, water erosion, and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Wooded drainageways provide browse and cover for wildlife.

This soil generally is unsuited to buildings and septic tank absorption fields because of the slope and the depth to bedrock. Better sites generally are nearby.

The land capability classification is VIIe. The range site is Shallow. The productivity index for spring wheat is 0.

11F—Cabba-Brandenburg complex, 3 to 45 percent slopes. These gently sloping to very steep soils are on hills and ridges on uplands that generally are dissected by many small drainageways. The Cabba soil is shallow and well drained, and the Brandenburg soil is shallow over porcellanite and is excessively drained. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 30 to 50 percent Cabba soil and 25 to 45 percent Brandenburg soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a grayish brown loam surface layer about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In some areas the soil is silty clay or fine sandy loam throughout. In a few places the surface layer is 8 to 12 inches thick. In places bedrock is at a depth of 20 to 40 inches.

Typically, the Brandenburg soil has a brown channery loam surface layer about 4 inches thick. The substratum is reddish brown very channery loam about 6 inches thick. Below this is red, shattered porcellanite. In places the depth to shattered porcellanite is 20 to 30 inches.

Included with these soils in mapping are small areas of Chama, Grail, Harriet, Rhoades, and Savage soils. These included soils make up about 10 to 25 percent of the unit. Chama soils are moderately deep. They are on side slopes. Grail and Savage soils are deep. Grail soils are dark to a depth of more than 16 inches. They are on foot slopes and toe slopes. Savage soils have a clay loam surface layer. They are on foot slopes and small alluvial fans. Harriet soils are poorly drained and are in drainageways. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderate in the Cabba soil. It is moderate in the upper part of the Brandenburg soil and rapid in the lower part. Runoff is very rapid on both soils. Available water capacity is very low. Root penetration is restricted by the soft bedrock at a depth of about 10 inches in the Cabba soil and by the shattered porcellanite at a depth of about 10 inches in the Brandenburg soil.

Most areas are used for range. These soils generally are unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of the slope, droughtiness, and the hazard of water erosion. Soil blowing is a moderate hazard and water erosion a severe hazard.

The important range forage plants on these soils are little bluestem, needleandthread, and blue grama. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

These soils generally are unsuited to buildings and septic tank absorption fields because of the slope and the shallow depth to bedrock. Better sites generally are nearby.

The land capability classification of the Cabba soil is VIIe, and that of the Brandenburg soil is VIIs. The range site of the Cabba soil is Shallow, and that of the Brandenburg soil is Very Shallow. The productivity index of the map unit for spring wheat is 0.

12C—Chama-Cabba silt loams, 6 to 9 percent slopes. These moderately sloping, well drained soils are on uplands. The moderately deep Chama soil is on side slopes, and the shallow Cabba soil is on ridges and hills. Individual areas are irregular in shape and range from 10 to 50 acres in size. They are about 60 to 65 percent Chama soil and 25 to 35 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chama soil has a dark grayish brown silt loam surface layer about 6 inches thick. The subsoil is silt loam about 8 inches thick. It is grayish brown in the upper part and light gray in the lower part. The substratum is light gray silt loam about 20 inches thick. Below this is soft siltstone bedrock. In some places lime is below a depth of 10 inches. In other places the soil is loam throughout. In a few areas, the subsoil contains more clay and the surface layer is silty clay loam.

Typically, the Cabba soil has a dark grayish brown silt loam surface layer about 4 inches thick. The substratum is grayish brown silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the soil is silty clay throughout.

Included with these soils in mapping are small areas of Arnegard, Brandenburg, Grail, Moreau, and Rhoades soils. These included soils make up about 5 to 15 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Brandenburg soils are underlain by shattered porcellanite. They are on ridges and hills. Grail soils are dark to a depth of more than 16 inches. They are on foot slopes. Moreau soils are moderately deep and contain more clay than the Chama soil. They are on side slopes. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderate in the Chama and Cabba soils, and runoff is medium. Available water capacity is moderate in the Chama soil and very low in the Cabba soil. Root penetration is restricted by the soft bedrock at a depth of about 34 inches in the Chama soil and 14 inches in the Cabba soil. The surface layer of both soils is friable or very friable and can be easily tilled. Tilth is good.

Most areas are used for range, hay, or pasture, but some are used for cultivated crops. These soils are poorly suited to corn, flax, and small grain because of the slope and the erosion hazard. Soil blowing is a moderate hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, needleandthread, blue grama, and little bluestem. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Chama soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock also is a limitation, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for absorption fields.

The land capability classification of the Chama soil is IIIe, and that of the Cabba soil is VIe. The range site of the Chama soil is Silty, and that of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 41.

12D—Chama-Cabba silt loams, 9 to 15 percent slopes. These strongly sloping, well drained soils are on uplands that generally are dissected by small drainageways. The moderately deep Chama soil is on side slopes, and the shallow Cabba soil is on ridges and hills. Individual areas are irregular in shape and range from 10 to more than 50 acres in size. They are about 35 to 55 percent Chama soil and 35 to 50 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chama soil has a dark grayish brown silt loam surface layer about 6 inches thick. The subsoil is silt loam about 8 inches thick. It is grayish brown in the upper part and light gray in the lower part. The substratum is light gray silt loam about 20 inches thick. Below this is soft siltstone bedrock. In some places lime is below a depth of 10 inches. In other places the soil is loam throughout.

Typically, the Cabba soil has a dark grayish brown silt loam surface layer about 4 inches thick. The substratum is grayish brown silt loam about 10 inches thick. Below this is soft siltstone bedrock. In places the soil is silty clay throughout.

Included with these soils in mapping are small areas of Arnegard, Moreau, and Rhoades soils. These included soils make up about 5 to 15 percent of the unit. Arnegard soils are dark to a depth of more than 16 inches. They are on foot slopes. Moreau soils are moderately deep and contain more clay than the Chama soil. They are on side slopes. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderate in the Chama and Cabba soils, and runoff is rapid. Available water capacity is very low in the Cabba soil and moderate in the Chama soil. Root penetration is restricted by the soft bedrock at a depth of about 14 inches in the Cabba soil and 34 inches in the Chama soil. Tilth is good in both soils.

Most areas are used for range, hay, or pasture, but some are used for cultivated crops. These soils are suited to pasture and hay but are poorly suited to corn, flax, and small grain because of the slope and the erosion hazard. Soil blowing is a moderate hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, needleandthread, blue grama, and little bluestem. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Chama soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock also is a limitation, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for absorption fields. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the absorption fields and buildings so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification of the Chama soil is IVe, and that of the Cabba soil is VIe. The range site of the Chama soil is Silty, and that of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 29.

13F—Badland-Cabba complex, 3 to 120 percent slopes. This gently sloping to very steep map unit consists of Badland intermingled with areas of a shallow, well drained Cabba soil. The unit is on uplands. Individual areas are irregular in shape and range from 10 to 50 acres in size. They are about 60 percent Badland

and 15 percent Cabba soil. The Cabba soil and Badland occur as areas so intricately mixed or so small that mapping them separately is not practical.

The Badland consists of eroding, cone-shaped knobs, buttes, escarpments, and nearly vertical walls. It supports no vegetation.

Typically, the Cabba soil has a grayish brown loam surface layer about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In places the soil is fine sandy loam throughout.

Included with this unit in mapping are small areas of Desart, Ekalaka, Lemert, and Vebar soils. These included soils make up about 25 percent of the unit. Desart, Ekalaka, and Lemert soils have an alkali subsoil. They are on foot slopes. Vebar soils are moderately deep and have a fine sandy loam surface layer. They are on side slopes. Also included are some areas of moderately deep and deep soils on the top of buttes and ridges.

Permeability is moderate in the Cabba soil, and runoff is very rapid. Available water capacity is very low. Root penetration is restricted by the soft bedrock at a depth of about 10 inches.

Most areas are used for range and wildlife habitat. This map unit generally is unsuited to cultivated crops, to trees and shrubs, and to grasses and legumes for hay or pasture because of the slope and the Badland. Soil blowing is a moderate hazard and water erosion a severe hazard.

Some areas can be used for grazing, but the vegetated areas are small and scattered or are on the top of nearly inaccessible buttes. The key plants are little bluestem, needleandthread, and western wheatgrass. Soil blowing and droughtiness are problems if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This map unit generally is unsuited to buildings and septic tank absorption fields because of the slope and the shallow depth to bedrock. It generally is not used as a building site or an absorption field in this survey area. Better sites generally are nearby.

The land capability classification of the Badland is VIIIe, and that of the Cabba soil is VIIe. The Badland is not assigned to a range site. The range site of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 0.

15B—Daglum loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained, alkali soil is on foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The next part is light brownish gray silty clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay loam. In places the soil does not have a subsurface layer.

Included with this soil in mapping are small areas of Grail, Lawther, and Rhoades soils. These soils make up about 15 to 25 percent of the unit. Grail and Rhoades soils are on foot slopes. Grail soils are nonalkali and are dark to a depth of more than 16 inches. Rhoades soils have a dense, alkali subsoil less than 6 inches below the surface. Lawther soils are nonalkali, are deep, and have a silty clay surface layer.

Permeability is very slow in the Daglum soil, and runoff is medium. Available water capacity is moderate. Root penetration is restricted by the dense, alkali subsoil at a depth of about 10 inches. Where cultivated, the surface soil and subsoil are frequently mixed. As a result, the clay content of the surface layer is increased and tillage is more difficult. Tilth is fair.

Most areas are used for hay, pasture, or range. This soil is poorly suited to corn, flax, and small grain because of alkalinity and droughtiness. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and stripcropping help to control water erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. Plowing to a depth of about 2 feet helps to break up the dense subsoil and increases the rate of water infiltration; however, mixing the subsoil and surface layer increases the clay content of the plow layer.

The important range forage plants on this soil are western wheatgrass and blue grama. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. Reestablishing vegetation is difficult in denuded areas because the dense subsoil restricts root penetration and the salts in the soil reduce the amount of water available to plants. Maintaining an adequate cover of the key plants helps to control water erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to only a few of the most drought and salt tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings.

Supplemental watering and control of the ground cover help to ensure survival of seedlings. Individual trees and shrubs vary in height, density, and vigor because root development is restricted in the dense, alkali subsoil and the salts in the soil reduce the amount of water available to plants.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The very slow permeability is a limitation in septic tank absorption fields, but it can be overcome by a mound system.

The land capability classification is IVs. The range site is Claypan. The productivity index for spring wheat is 30.

19F—Cabba loam, 15 to 45 percent slopes, extremely stony. This shallow, moderately steep to very steep, well drained soil is on ridges and hills on uplands that commonly are dissected by entrenched drainageways. About 25 percent of the surface is covered with stones and boulders. Individual areas are irregular in shape and range from 25 to more than 100 acres in size.

Typically, the surface layer is grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silt loam about 4 inches thick. Below this is soft siltstone bedrock. In some places the soil is fine sandy loam throughout. In other places the bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Arnegard and Rhoades soils. These soils make up about 5 to 25 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Rhoades soils have an alkali subsoil. They are on foot slopes and side slopes.

Permeability is moderate in the Cabba soil, and runoff is rapid. Available water capacity is very low. Root penetration is restricted by the soft bedrock at a depth of about 10 inches.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of droughtiness, the slope, and the stoniness. Soil blowing is a slight hazard and water erosion a severe hazard.

The important range forage plants on this soil are little bluestem, needleandthread, and western wheatgrass. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil generally is unsuited to buildings and septic tank absorption fields because of the slope and the depth to bedrock. Better sites generally are nearby.

The land capability classification is VIIs. The range site is Shallow. The productivity index for spring wheat is 0.

20B—Desart fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained, alkali soil is on terraces and on foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface soil is about 17 inches thick. It is dark grayish brown fine sandy loam in the upper part and grayish brown very fine sandy loam in the lower part. The subsurface layer is very fine sandy loam about 8 inches thick. It is light brownish gray in the upper part and gray in the lower part. The subsoil is about 13 inches thick. It is light olive gray very fine sandy loam in the upper part and light gray loam in the lower part. The substratum is light gray loamy fine sand about 10 inches thick. Below this is soft sandstone bedrock. In places the depth to the subsoil is only 9 to 20 inches.

Included with this soil in mapping are small areas of Lemert and Lihen soils. These soils make up about 5 to 25 percent of the unit. Lemert soils have salts near the surface. They occur as areas intermingled with areas of the Desart soil. Lihen soils are nonalkali. They are in swales.

Permeability is slow in the Desart soil. Runoff also is slow. Available water capacity is moderate. Root penetration is restricted by the dense, alkali subsoil at a depth of about 25 inches. The surface soil is very friable and can be easily tilled. Tilth is good.

Most areas are used for range, hay, or pasture. This soil is poorly suited to corn, flax, and small grain because of alkalinity and droughtiness. Soil blowing is a severe hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion and soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, buffer strips, grassed waterways in areas where runoff concentrates, and contour stripcropping help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are prairie sandreed, blue grama, and needleandthread. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to only a few of the most drought and salt tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Supplemental watering and control of the ground cover help to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor because root development is restricted in the dense subsoil and the salts in the soil reduce the amount of water available to plants. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on this soil, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The slow permeability is a limitation in septic tank absorption fields, but enlarging the field helps to overcome this limitation.

The land capability classification is IVe. The range site is Sandy. The productivity index for spring wheat is 46.

25C—Ekalaka-Lemert fine sandy loams, 1 to 9 percent slopes. These deep, moderately well drained, alkali soils are on terraces and on foot slopes in the uplands. The Ekalaka soil is nearly level to moderately sloping, and the Lemert soil is nearly level. Individual areas are irregular in shape and range from 20 to more than 300 acres in size. They are about 50 to 75 percent Ekalaka soil and 20 to 45 percent Lemert soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ekalaka soil has a dark grayish brown fine sandy loam surface layer about 6 inches thick. The subsurface layer is light brownish gray fine sandy loam about 6 inches thick. The subsoil is about 13 inches thick. It is dark grayish brown fine sandy loam in the upper part, grayish brown fine sandy loam in the next part, and pale brown loamy fine sand in the lower part. The substratum to a depth of about 60 inches is fine sandy loam. It is grayish brown and mottled in the upper part and light gray in the lower part. In a few places the depth to the subsoil is more than 20 inches.

Typically, the Lemert soil has a dark grayish brown fine sandy loam surface layer about 2 inches thick. The subsurface layer is light brownish gray fine sandy loam about 3 inches thick. The subsoil is about 19 inches thick. It is dark grayish brown fine sandy loam in the upper part, grayish brown fine sandy loam in the next part, and pale brown loamy fine sand in the lower part. The upper part of the substratum is pale brown loamy fine sand. The lower part to a depth of about 60 inches is light gray fine sandy loam. In places the soil contains more clay throughout.

Included with these soils in mapping are small areas of Flasher, Lihen, Telfer, and Vebar soils. These included soils make up about 5 to 15 percent of the unit. Flasher soils have soft bedrock at a depth of 10 to 20 inches. They are on knobs. Lihen, Telfer, and Vebar soils are nonalkali. They are on side slopes. Also included are some slick spots, which are barren of vegetation.

Permeability is slow in the Ekalaka and Lemert soils. Runoff also is slow. Available water capacity is low. Root penetration is restricted by the dense, alkali subsoil at a depth of about 12 inches in the Ekalaka soil and 5 inches in the Lemert soil.

Most areas are used for range (fig. 8). These soils are best suited to this use. They generally are unsuited to cultivated crops and hay because of droughtiness and the content of salts. Soil blowing is a severe hazard and water erosion a moderate hazard.

The important range forage plants on these soils are needleandthread, western wheatgrass, and blue grama. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture plants. The dense subsoil, which restricts root penetration, and the salts, which reduce the amount of water available to plants, are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Stock water ponds constructed in these soils sometimes contain salty water.

These soils are suited to only a few of the most drought and salt tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Supplemental watering and control of the ground cover help to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor because root development is restricted in the dense subsoil and the salts in the soils reduce the amount of water available to plants. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on these soils, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The slow permeability is a limitation in septic tank absorption fields, but enlarging the field helps to overcome this limitation.

The land capability classification of the Ekalaka soil is VIe, and that of the Lemert soil is VIs. The range site of the Ekalaka soil is Sandy Claypan, and that of the Lemert soil is Thin Claypan. The productivity index of the map unit for spring wheat is 0.

30F—Flasher loamy fine sand, 15 to 45 percent slopes. This shallow, moderately steep to very steep, somewhat excessively drained soil is on hills and ridges on uplands that generally are dissected by intermittent drainageways. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 6 inches thick. The substratum is light olive brown loamy fine sand about 4 inches thick.

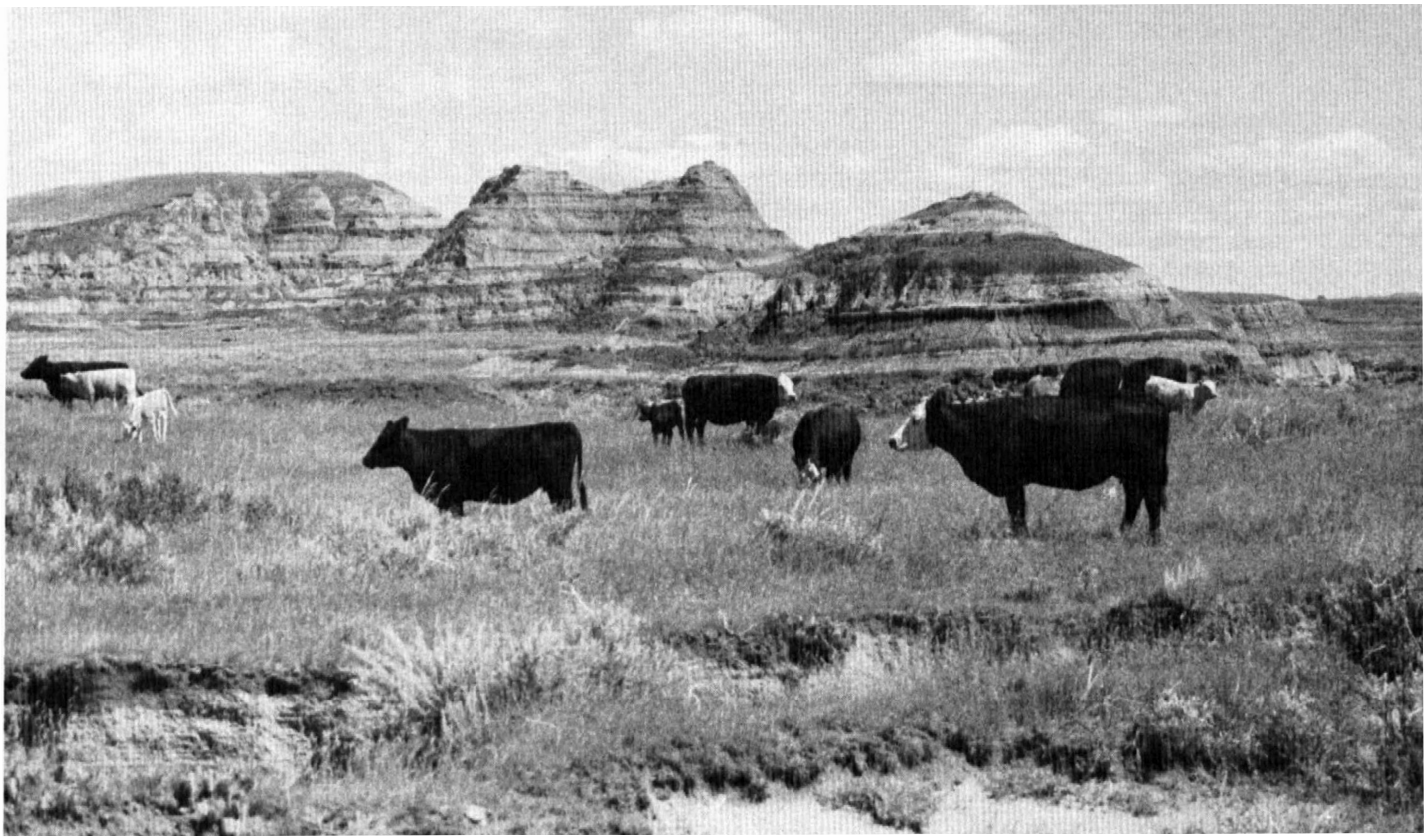


Figure 8.—An area of Ekalaka-Lemert fine sandy loams, 1 to 9 percent slopes, used as range. Badland is in the background.

Below this is soft sandstone bedrock. In some places the soil is loam, silt loam, or fine sandy loam throughout. In other places it is 20 to 30 inches deep over sandstone bedrock.

Included with this soil in mapping are small areas of Arnegard, Parshall, Regan, Schaller, Telfer, and Vebar soils. These soils make up about 25 percent of the unit. Arnegard and Parshall soils are deep and are dark to a depth of more than 16 inches. They are in swales. Regan soils are poorly drained. They are in narrow drainageways. Schaller soils are deep. They are on knobs above the Flasher soil. Telfer and Vebar soils are on side slopes. Telfer soils are deep, and Vebar soils are moderately deep. Also included are some areas of rock outcrop.

Permeability is moderately rapid in the Flasher soil, and runoff is rapid. Available water capacity is very low. Root penetration is restricted by the soft sandstone bedrock at a depth of about 10 inches.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of the slope and droughtiness. Soil blowing and water erosion are severe hazards.

The important range forage plants on this soil are little bluestem, prairie sandreed, and needleandthread. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Wooded drainageways provide browse and cover for wildlife.

This soil generally is unsuited to buildings and septic tank absorption fields because of the shallow depth to bedrock and the slope. Better sites generally are nearby.

The land capability classification is VIIe. The range site is Shallow. The productivity index for spring wheat is 0.

31F—Flasher loamy fine sand, 15 to 45 percent slopes, extremely stony. This shallow, moderately steep to very steep, somewhat excessively drained soil is on hills and ridges in the uplands. About 15 to 35 percent of the surface is covered with stones and boulders. Individual areas are irregular in shape and range from 20 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 3 inches thick. The substratum is light olive brown loamy fine sand about 7 inches thick. Below this is soft sandstone bedrock. In some places the soil is fine sandy loam throughout. In other places the bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Arnegard, Parshall, Telfer, and Vebar soils. These soils make up about 10 to 20 percent of the unit. Arnegard and Parshall soils are deep and are dark to a depth of more than 16 inches. They are on foot slopes and toe slopes. Telfer soils are deep. They are in swales and on the lower side slopes. Vebar soils are moderately deep. They are on side slopes.

Permeability is moderately rapid in the Flasher soil, and runoff is rapid. Available water capacity is very low. Root penetration is restricted by the soft sandstone bedrock at a depth of about 10 inches.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of droughtiness, the slope, and the stoniness. Soil blowing and water erosion are severe hazards.

The important range forage plants on this soil are little bluestem, prairie sandreed, and needleandthread. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil generally is unsuited to buildings and septic tank absorption fields because of the depth to bedrock and the slope. Better sites generally are nearby.

The land capability classification is VIIs. The range site is Shallow. The productivity index for spring wheat is 0.

33—Arveson fine sandy loam. This deep, level, poorly drained, highly calcareous soil is in swales and depressions on uplands. Individual areas are long and narrow and range from 50 to more than 300 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 6 inches thick. The next layer is grayish brown loamy sand about 9 inches thick. The subsoil is gray loam about 6 inches thick. The upper part of the substratum is very dark gray loam. The lower part to a depth of about 60 inches is grayish brown loamy sand. In some places the soil contains more sand. In other places the surface layer is sandy loam or loam. Some small areas are subject to ponding.

Included with this soil in mapping are small areas of Harriet, Regan, and Telfer soils. These soils make up 10 to 25 percent of the unit. Harriet soils have an alkali subsoil. They are in narrow drainageways. Regan and Telfer soils are on rises. Regan soils have a clay loam surface layer. Telfer soils are excessively drained.

Permeability is moderately rapid in the Arveson soil, and runoff is slow. Available water capacity is moderate. A seasonal high water table is at a depth of 1 to 2 feet. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for range or native hay. This soil is poorly suited to corn, flax, and small grain. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and field windbreaks help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are big bluestem, indiangrass, and prairie cordgrass. Soil blowing is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control soil blowing, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas, however, generally are unsuited. The wetness is a critical limitation affecting survival, growth, and vigor. The grasses and weeds growing on this soil are abundant and persistent. Eliminating the ground cover before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion. Some areas support a stand of eastern cottonwood, quaking aspen, and willow.

This soil generally is unsuited to buildings and septic tank absorption fields because of the seasonal high water table. Better sites generally are nearby.

The land capability classification is IIIw. The range site is Subirrigated. The productivity index for spring wheat is 48.

35—Grail silty clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is about

28 inches thick. It is dark grayish brown clay in the upper part, dark grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray. It is loam in the upper part and clay loam in the lower part. In some places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In other places the surface layer is silty clay.

Included with this soil in mapping are small areas of Belfield and Daglum soils in swales and on flats. These soils make up about 10 to 15 percent of the unit. They have an alkali subsoil.

Permeability is moderately slow in the Grail soil, and runoff is very slow. Available water capacity is high. The surface is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining tilth and the content of organic matter is the main management concern if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility and increases the rate of water infiltration.

The important range forage plants on this soil are big bluestem, green needlegrass, and western wheatgrass. Smooth bromegrass, green needlegrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Overflow. The productivity index for spring wheat is 90.

37—Grail-Belfield-Daglum complex, 1 to 3 percent slopes. These deep, nearly level soils are on foot slopes in the uplands. The Grail soil is well drained, the Belfield soil is well drained and alkali, and the Daglum soil is moderately well drained and alkali. Individual areas are irregular in shape and range from 10 to more than 50 acres in size. They are about 40 to 50 percent Grail soil, 25 to 35 percent Belfield soil, and 20 to 30 percent Daglum soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Grail soil has a very dark grayish brown silty clay loam surface layer about 8 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown clay in the upper part, dark grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray. It is loam in the upper part and clay loam in the lower part. In some places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In other places the surface layer is silty clay or clay loam.

Typically, the Belfield soil has a loam surface layer about 12 inches thick. This layer is very dark grayish brown in the upper part and dark brown in the lower part. The next 4 inches is dark grayish brown clay loam that has light brownish gray silt coatings. The subsoil is about 44 inches thick. In sequence downward, it is very dark grayish brown clay loam, grayish brown silty clay, grayish brown clay loam, and grayish brown loam. In places the surface soil is clay loam or silty clay loam.

Typically, the Daglum soil has a dark grayish brown loam surface layer about 7 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The next part is light brownish gray silty clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay loam. In some places the surface layer is only 1 to 5 inches thick, and in other places it is silt loam.

Included with these soils in mapping are small areas of Shambo soils on alluvial fans. These included soils have a loam surface layer and subsoil. They make up about 5 percent of the unit.

Permeability is moderately slow in the Grail soil, slow in the Belfield soil, and very slow in the Daglum soil. Runoff is slow on all three soils. Available water capacity is high in the Grail and Belfield soils and moderate in the Daglum soil. Root penetration is restricted by the dense, alkali subsoil at a depth of about 16 inches in the Belfield soil and 10 inches in the Daglum soil. The surface layer of all three soils is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. These soils are suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining or improving tilth and maintaining the content of organic matter are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are big bluestem, western wheatgrass, and blue grama. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of these soils as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and plant cover for rangeland wildlife, and permits regrowth of browse plants.

The Grail soil is suited to all, the Belfield soil to many, and the Daglum soil to some of the trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect trees and shrubs on the Grail and Belfield soils. Individual trees and shrubs on the Daglum soil vary in height, density, and vigor because root development is restricted by the dense, alkali subsoil and the salts in the soil reduce the available water capacity. Eliminating grasses and weeds before the trees are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The restricted permeability of the three soils is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The Belfield and Grail soils are better sites for absorption fields than the Daglum soil.

The land capability classification of the Grail soil is IIc, that of the Belfield soil is IIIs, and that of the Daglum soil is IVs. The range site of the Grail soil is Overflow, that of the Belfield soil is Clayey, and that of the Daglum soil is Claypan. The productivity index of the map unit for spring wheat is 73.

40—Harriet loam, 1 to 3 percent slopes. This deep, nearly level, poorly drained, alkali, saline soil is in drainageways and depressions and on flats on terraces and flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 20 to more than 100 acres in size.

Typically, the surface layer is gray and light gray loam about 2 inches thick. The subsoil is dark grayish brown clay loam about 8 inches thick. The upper part of the substratum is grayish brown loam. The next part is dark grayish brown clay loam. The lower part to a depth of about 60 inches is light brownish gray clay loam. In some places lime is at a depth of 15 inches or more. In other places the soil is fine sandy loam throughout.

Included with this soil in mapping are small areas of Regan soils on slight rises. These soils have accumulations of lime within a depth of 16 inches. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Harriet soil. Runoff also is very slow. Available water capacity is moderate. A seasonal high water table is within a depth of 1 foot. Root penetration is restricted by the dense, alkali part of the subsoil at a depth of about 4 inches. The high salt content restricts the growth of plants.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture or hay, and to windbreaks and environmental plantings because of the salts and the high water table. Soil blowing and water erosion are slight hazards.

The important range forage plants on this soil are Nuttall alkaligrass, inland saltgrass, and western wheatgrass. The high salt content, a reduced amount of available water, compaction, trampling, and root shearing are problems if the range is grazed when the soil is wet. They can be overcome by maintaining adequate amounts of the key salt-tolerant plants and by deferring grazing while the soil is wet. Stock water ponds constructed in this soil frequently contain salty water.

This soil generally is unsuited to buildings and septic tank absorption fields because of the seasonal high water table and the flooding. Better sites generally are nearby.

The land capability classification is VIs. The range site is Saline Lowland. The productivity index for spring wheat is 0.

41—Heil silty clay. This deep, level, poorly drained, alkali soil is in depressions on uplands. It is periodically ponded. Individual areas are circular or oblong and range from 10 to more than 100 acres in size.

Typically, the surface layer is gray, mottled silty clay about 2 inches thick. The subsoil is dark gray clay about 24 inches thick. The substratum to a depth of about 60 inches is gray clay. In places the depth to lime is only 2 to 10 inches.

Included with this soil in mapping are small areas of the well drained Grail soils on the rim of the depressions. These soils make up about 5 percent of the unit. Also included are some areas of very poorly drained soils in the deeper part of the depressions.

Permeability is very slow in the Heil soil, and runoff is ponded. Available water capacity is high. A seasonal high water table is 1 foot above to 1 foot below the surface. Root penetration is restricted by the dense, alkali subsoil at a depth of about 2 inches.

Most areas are used for range or hay. This soil generally is unsuited to cultivated crops, pasture, and windbreaks and environmental plantings because of the salts and the high water table. Soil blowing is a moderate hazard and water erosion a slight hazard.

The important range forage plants on this soil are western wheatgrass and prairie cordgrass. Compaction, trampling, and root shearing are problems if the range is grazed during wet periods. They can be overcome by deferring grazing when the soil is wet. Stock water ponds constructed in this soil sometimes contain salty water.

This soil generally is unsuited to buildings and septic tank absorption fields because of the ponding and the seasonal high water table. Better sites generally are nearby.

The land capability classification is VIs. The range site is Closed Depression. The productivity index for spring wheat is 0.

42—Lawther silty clay, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and in swales on uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is dark gray silty clay about 5 inches thick. The subsoil is clay about 28 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The substratum to a depth of about 60 inches is dark gray silty clay. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Heil soils in depressions. These soils make up about 10 percent of the unit.

Permeability is slow in the Lawther soil, and runoff is very slow. Available water capacity is high. The surface layer can be easily tilled only within a narrow range of moisture content. It becomes hard and cloddy when dry and sticky when wet. Tilth is poor.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a moderate hazard and water erosion a slight hazard. Maintaining or improving tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass and green needlegrass. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field or by installing a mound system.

The land capability classification is IIs. The range site is Clayey. The productivity index for spring wheat is 86.

44B—Lihen loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface soil is loamy fine sand about 14 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown loamy fine sand about 13 inches thick. The substratum to a depth of about 60 inches is grayish brown loamy sand. In places the soil is fine sandy loam throughout. In a few areas the dark color of the surface soil extends to a depth of only 8 to 20 inches.

Included with this soil in mapping are small areas of Desart, Ekalaka, and Seroco soils. These soils make up about 10 percent of the unit. Desart and Ekalaka soils have an alkali subsoil. They are on foot slopes. Seroco soils have a surface layer that is thinner than that of the Lihen soil. They are on knobs, ridges, and hummocks.

Permeability is rapid in the Lihen soil, and runoff is slow. Available water capacity is low. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for range, hay, or pasture. This soil is poorly suited to corn, flax, and small grain and to grasses and legumes for pasture and hay because of soil blowing and the low available water capacity. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, and stripcropping help to prevent excessive soil loss. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are prairie sandreed and needleandthread. Intermediate wheatgrass, pubescent wheatgrass, prairie sandreed, and alfalfa are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. Because of the rapid permeability, the soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution.

The land capability classification is IVe. The range site is Sands. The productivity index for spring wheat is 50.

46—Dumps and pits, mine. This map unit consists of steep mine-spoil dumps and nearly level open pits. It is in areas where soil material and overburden have been removed and lignite, gravel, or scoria (porcellanite) has been mined. The soil material and overburden have been mixed in the mining process. Generally, the pits are ponded during part of the year. Individual areas range from about 10 to 160 acres in size. The dumps and pits occur as areas so intricately mixed or so small that mapping them separately is not practical.

Most areas have been abandoned and are not used for any particular purpose, but a few are used as landfills. Unless reclaimed, this map unit generally is unsuited to most uses, except for wildlife habitat. Some grasses, trees, shrubs, and weeds are established, but plant density is low. Some wildlife species use the unit for nesting, feeding, or protection from predators. Onsite investigation is necessary to plan and design specific uses and reclamation of this unit.

The land capability classification is VIIIe. No range site is assigned. The productivity index for spring wheat is 0.

48B—Moreau clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes and knolls in the uplands. Individual areas are irregular in shape and range from 10 to more than 200 acres in size.

Typically, the surface layer is grayish brown clay loam about 5 inches thick. The subsoil is silty clay about 7 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light yellowish brown silty clay about 9 inches thick. Below this is soft shale bedrock. In some places the surface layer is 7 or more inches thick and is dark grayish brown. In other places the soil is silt loam throughout.

Included with this soil in mapping are small areas of Cabba, Grail, Rhoades, and Savage soils. These soils make up about 10 to 25 percent of the unit. Cabba soils have soft bedrock at a depth of 10 to 20 inches. They are on ridges. Grail soils are deep and are dark to a depth of more than 16 inches. They are in swales. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes. Savage soils are deep. They are on foot slopes.

Permeability is slow in the Moreau soil, and runoff is medium. Available water capacity is low. Root penetration is restricted by the soft bedrock at a depth of about 21 inches. The surface layer is firm and can be easily tilled only within a narrow range of moisture content. It is hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are moderate hazards. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass and green needlegrass. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The effluent can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIIe. The range site is Clayey. The productivity index for spring wheat is 58.

48C—Moreau clay loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes and knolls in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown clay loam about 5 inches thick. The subsoil is silty clay about 7 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light yellowish brown silty clay about 9 inches thick. Below this is soft shale bedrock. In some places the surface layer is 7 or more inches thick and is dark grayish brown. In other places the depth to bedrock is less than 20 inches. In some areas the substratum is clay loam. In other areas the soil is loam throughout.

Included with this soil in mapping are small areas of Brandenburg, Cabba, Grail, Rhoades, and Savage soils. These soils make up about 15 to 25 percent of the unit. Brandenburg and Cabba soils are on ridges. Brandenburg soils are underlain by shattered porcellanite at a depth of about 10 inches. Cabba soils have soft bedrock at a depth of 10 to 20 inches. Grail soils are deep and are dark to a depth of more than 16 inches. They are in swales. Rhoades soils have an alkali subsoil. They are in microdepressions. Savage soils are deep. They are on foot slopes.

Permeability is slow in the Moreau soil, and runoff is rapid. Available water capacity is low. Root penetration is restricted by the soft bedrock at a depth of about 21 inches. The surface layer is firm and can be easily tilled only within a narrow range of moisture content. It is hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a moderate hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to prevent excessive soil loss. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are green needlegrass and western wheatgrass. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The effluent can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IVe. The range site is Clayey. The productivity index for spring wheat is 42.

52—Regan clay loam, 0 to 3 percent slopes. This deep, level and nearly level, poorly drained, highly calcareous, slightly saline soil is on flood plains and in upland swales that accumulate runoff and seepage. It is occasionally flooded. Individual areas are long and narrow and range from 10 to more than 100 acres in size.

Typically, the surface soil is clay loam about 11 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The subsoil is light gray and dark gray clay loam about 9 inches thick. The substratum to a depth of about 60 inches is clay loam. It is dark gray in the upper part, dark grayish brown in the next part, and light brownish gray in the lower part. In places the surface layer is loam or silt loam.

Included with this soil in mapping are small areas of Arnegard, Harriet, Parshall, and Straw soils. These soils make up about 10 to 20 percent of the unit. Arnegard, Parshall, and Straw soils are well drained and are on rises. They do not have an accumulation of lime within a depth of 16 inches. Harriet soils have an alkali subsoil. They occur as areas intermingled with areas of the Regan soil.

Permeability is moderately slow in the Regan soil, and runoff is very slow. Available water capacity is high. A seasonal high water table is within a depth of 1 foot. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for range or native hay. This soil is best suited to these uses. It is poorly suited to corn, flax, and small grain because of the wetness. Soil blowing is a moderate hazard and water erosion a slight hazard. Maintenance of tilth, delayed tillage and seeding, the wetness, the content of salts, and the hazard of soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and field windbreaks help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. Surface salinity has increased in some cultivated areas. The soil is subject to the development of saline seeps.

The important range forage plants on this soil are prairie cordgrass and slim sedge. Creeping foxtail, reed canarygrass, and alsike clover are suitable pasture and hay plants. Compaction, trampling, and root shearing are problems if the range is grazed during wet periods. They can be overcome by deferring grazing when the soil is wet. Maintaining an adequate cover of the key plants helps to control soil blowing, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Individual trees and shrubs vary in height, density, and vigor because the salts in the soil reduce the amount of available water. Seedling losses can be high in tilled or fallowed areas. Measures that reduce the evaporation rate at the surface increase the seedling survival rate. When a bare surface dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

This soil generally is unsuited to buildings and septic tank absorption fields because of the seasonal high water table and the flooding. Better sites generally are nearby.

The land capability classification is IIIs. The range site is Subirrigated. The productivity index for spring wheat is 34.

53B—Regent silty clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is dark grayish brown silty clay, grayish brown silty clay loam, light brownish gray silty clay, and light olive gray silty clay loam. Below this is soft shale bedrock. In some places the soil is loam or silt loam throughout. In other places the depth to soft shale is more than 40 inches. In some areas the surface layer is silty clay.

Included with this soil in mapping are small areas of Cabba, Daglum, and Rhoades soils. These soils make up about 15 to 25 percent of the unit. Cabba soils have soft bedrock at a depth of 10 to 20 inches. They are on ridges. Daglum and Rhoades soils have an alkali subsoil. Daglum soils are on foot slopes, and Rhoades soils are on side slopes and foot slopes.

Permeability is slow in the Regent soil, and runoff is medium. Available water capacity is moderate. Root penetration is restricted by the soft bedrock at a depth of about 35 inches. The surface layer is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass and green needlegrass. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The effluent can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIe. The range site is Clayey. The productivity index for spring wheat is 67.

53C—Regent silty clay loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is dark grayish brown silty clay, grayish brown silty clay loam, light brownish gray silty clay, and light olive gray silty clay loam. Below this is soft shale bedrock. In some places the soil is loam or clay loam throughout. In other places the surface layer is silty clay.

Included with this soil in mapping are small areas of the shallow Cabba soils on ridges. These soils make up about 10 percent of the unit.

Permeability is slow in the Regent soil, and runoff is rapid. Available water capacity is moderate. Root penetration is restricted by the soft bedrock at a depth of about 35 inches. The surface layer is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass and green needlegrass. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field. The effluent can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIIe. The range site is Clayey. The productivity index for spring wheat is 61.

54B—Regent-Rhoades complex, 3 to 6 percent slopes. These moderately deep, gently sloping soils are on side slopes in the uplands. The Regent soil is well drained, and the Rhoades soil is moderately well drained and alkali. Individual areas are irregular in shape and range from 10 to more than 50 acres in size. They are about 55 to 65 percent Regent soil and 30 to 35 percent Rhoades soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Regent soil has a dark grayish brown silty clay loam surface layer about 4 inches thick. The subsoil is about 29 inches thick. In sequence downward, it is dark grayish brown silty clay, grayish brown silty clay loam, light brownish gray silty clay, and light olive gray silty clay loam. Below this is soft shale bedrock. In some places the soil is loam or silt loam throughout. In other places, the surface layer is silty clay and the soil is calcareous throughout.

Typically, the Rhoades soil has a dark grayish brown loam surface layer about 4 inches thick. The subsurface layer is grayish brown silt loam about 2 inches thick. The subsoil is silty clay about 12 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is grayish brown silty clay about 20 inches thick. Below this is soft shale bedrock.

In a few places the dense subsoil is at a depth of 6 to 12 inches. In some areas the depth to soft bedrock is 40 to 60 inches.

Included with these soils in mapping are small areas of Cabba, Grail, and Savage soils. These included soils make up about 5 to 15 percent of the unit. Cabba soils have soft bedrock within a depth of 20 inches. They are on ridges. Grail soils are deep and are dark to a depth of more than 16 inches. They are in swales. Savage soils are deep and nonalkali. They are on foot slopes.

Permeability is slow in the Regent soil and very slow in the Rhoades soil. Runoff is medium on both soils. Available water capacity is moderate in the Regent soil and low in the Rhoades soil. Root penetration is restricted by the soft bedrock at a depth of about 33 inches in the Regent soil and by the dense, alkali subsoil at a depth of about 6 inches in the Rhoades soil. The surface layer of both soils can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. These soils are suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, green needlegrass, and blue grama. Crested wheatgrass, green needlegrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Regent soil is suited to many of the trees and shrubs grown as windbreaks and environmental plantings, but the Rhoades soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The restricted permeability in both soils is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field or installing a mound system. The Regent soil is a better site for waste disposal than the Rhoades soil. The effluent from septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for absorption fields.

The land capability classification of the Regent soil is IIe, and that of the Rhoades soil is VIs. The range site of the Regent soil is Clayey, and that of the Rhoades soil is Thin Claypan. The productivity index of the map unit for spring wheat is 53.

54C—Regent-Rhoades complex, 6 to 9 percent slopes. These moderately deep, moderately sloping soils are on side slopes in the uplands. The Regent soil is well drained, and the Rhoades soil is moderately well drained and alkali. Individual areas are irregular in shape and range from about 10 to 50 acres in size. They are about 50 to 70 percent Regent soil and 25 to 40 percent Rhoades soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Regent soil has a dark grayish brown silty clay loam surface layer about 6 inches thick. The subsoil is about 25 inches thick. It is dark grayish brown silty clay in the upper part and grayish brown silty clay loam in the lower part. Below this is soft shale bedrock. In some places the soil is loam throughout. In other places, the surface layer is silty clay and the soil is calcareous throughout.

Typically, the Rhoades soil has a dark grayish brown loam surface layer about 3 inches thick. The subsurface layer is grayish brown silt loam about 2 inches thick. The subsoil is silty clay about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is grayish brown silty clay about 22 inches thick. Below this is soft shale bedrock. In a few places the dense subsoil is at a depth of 6 to 12 inches.

Included with these soils in mapping are small areas of Cabba and Grail soils. These included soils make up about 5 to 10 percent of the unit. Cabba soils have soft bedrock at a depth of 10 to 20 inches. They are on ridges. Grail soils are deep and are dark to a depth of more than 16 inches. They are in swales.

Permeability is slow in the Regent soil and very slow in the Rhoades soil. Runoff is rapid on both soils. Available water capacity is moderate in the Regent soil and low in the Rhoades soil. Root penetration is restricted by the soft bedrock at a depth of about 31 inches in the Regent soil and by the dense, alkali subsoil at a depth of about 5 inches in the Rhoades soil. The surface layer of both soils is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. These soils are poorly suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a severe hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, green needlegrass, and blue grama. Crested wheatgrass, green needlegrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

The Regent soil is suited to many of the trees and shrubs grown as windbreaks and environmental plantings, but the Rhoades soil generally is unsuited. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The restricted permeability of both soils is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field or by installing a mound system. The Regent soil is a better site for waste disposal than the Rhoades soil. The effluent from septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for absorption fields.

The land capability classification of the Regent soil is IIIe, and that of the Rhoades soil is VIs. The range site of the Regent soil is Clayey, and that of the Rhoades soil is Thin Claypan. The productivity index of the map unit for spring wheat is 41.

55C—Rhoades-Daglum loams, 1 to 9 percent slopes. These deep, nearly level to moderately sloping, moderately well drained, alkali soils are on foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 60 to 70 percent Rhoades soil and 25 to 35 percent Daglum soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rhoades soil has a dark grayish brown loam surface layer about 3 inches thick. The subsurface layer is grayish brown silt loam about 2 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. The substratum to a depth of about 60 inches is grayish brown clay.

Typically, the Daglum soil has a dark grayish brown loam surface layer about 7 inches thick. The subsurface layer is grayish brown loam about 3 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The next part is light brownish gray silty clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay loam.

Included with these soils in mapping are small areas of Lawther, Savage, Straw, and Velva soils. These included soils make up 5 to 15 percent of the unit. They do not have an alkali subsoil. Lawther and Savage soils are in swales. Straw and Velva soils are in narrow drainageways. Also included are some barren slick spots.

Permeability is very slow in the Rhoades and Daglum soils, and runoff is medium. Available water capacity is moderate. Root penetration is restricted by the dense, alkali subsoil at a depth of about 5 inches in the Rhoades soil and 10 inches in the Daglum soil. In cultivated areas the surface layer and subsoil are frequently mixed. As a result, the surface layer is clayey in these areas and tillage is more difficult.

Most areas are used for range. These soils generally are unsuited to cultivated crops and to grasses and legumes for pasture and hay because of the content of sodium and salts. Soil blowing is a slight hazard and water erosion a severe hazard.

The important range forage plants on these soils are western wheatgrass and blue grama. The dense, alkali subsoil, which restricts root penetration, and the salts, which reduce the amount of water available to plants, are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Stock water ponds constructed in these soils sometimes contain salty water.

The Rhoades soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Daglum soil is suited to some trees and shrubs. Individual trees and shrubs vary in height, density, and vigor, however, because root development is restricted in the dense subsoil and the salts in the soil reduce the available water capacity.

If buildings are constructed on these soils, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The very slow permeability is a limitation in septic tank absorption fields, but it can be overcome by installing a mound system.

The land capability classification of the Rhoades soil is VIs, and that of the Daglum soil is IVs. The range site of the Rhoades soil is Thin Claypan, and that of the Daglum soil is Claypan. The productivity index of the map unit for spring wheat is 0.

56B—Ruso fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on terraces. It is underlain by sand and gravel at a depth of about 29 inches. Individual areas are irregular in shape and range from 10 to more than 300 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 19 inches thick. It is brown in the upper part and dark grayish brown in the lower part. The next layer is brown loamy sand about 5 inches thick. The upper part of the substratum is brown gravelly loamy coarse sand. The lower part to a depth of about 60 inches is light brownish gray fine sand. In some places the surface layer and subsoil are loam. In other places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In a few areas the depth to sand and gravel is more than 40 inches, and in some areas it is less than 20 inches.

Included with this soil in mapping are small areas of Ekalaka and Schaller soils. These soils make up about 5 to 15 percent of the unit. Ekalaka soils have a dense, alkali subsoil at a depth of 9 to 20 inches. Schaller soils have a thinner subsoil.

Permeability is moderately rapid in the upper part of the Ruso soil and very rapid in the lower part. Runoff is slow. Available water capacity is low. Root penetration is restricted by the sand and gravel at a depth of about 29 inches. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops or hay. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a moderate hazard. Maintaining tilth and controlling soil blowing and water erosion are the main management concerns if cultivated crops are grown. A conservation tillage system that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are needleandthread and prairie sandreed. Crested wheatgrass, western wheatgrass, and sweetclover are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. Because of the very rapid permeability, the soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 46.

57B—Savage clay loam, 2 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on alluvial fans and foot slopes in the uplands. Individual areas are irregular in shape and range from 10 to more than 150 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 6 inches thick. The subsoil is about 41 inches thick. In sequence downward, it is dark brown silty clay, grayish brown silty clay, grayish brown silty clay loam, and light brownish gray silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silty clay loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places soft bedrock is at a depth of 20 to 40 inches. In some areas the soil is loam throughout.

Included with this soil in mapping are small areas of Moreau and Rhoades soils. These soils make up about 5 to 10 percent of the unit. Moreau soils are moderately deep. They are on low knolls. Rhoades soils have an alkali subsoil. They are on foot slopes.

Permeability is slow in the Savage soil, and runoff is medium. Available water capacity is high. The surface layer is friable and can be easily tilled when moist, but it becomes hard and cloddy when dry and sticky when wet. Tilth is fair.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass, needleandthread, and blue grama. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants. Gullies can form along cattle trails. Cross fences that control the pattern of livestock traffic help to prevent gullying.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The slow permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Clayey. The productivity index for spring wheat is 74.

59D—Seroco-Blownout land complex, 3 to 15 percent slopes. This map unit occurs as areas of a deep, undulating to rolling, excessively drained Seroco soil intermingled with Blownout land. The unit is on uplands. Individual areas are irregular in shape and range from 20 to 120 acres in size. They are about 65 to 80 percent Seroco soil and 15 to 20 percent Blownout land. The Seroco soil and Blownout land occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Seroco soil has a dark grayish brown loamy fine sand surface layer about 7 inches thick. The upper part of the substratum is brown loamy sand. The lower part to a depth of about 60 inches is light olive brown loamy fine sand. In places the surface layer is fine sandy loam.

The Blownout land consists of areas from which soil material has been removed by the wind. The land has no vegetation and is characterized by barren hummocks and dunes.

Included with this unit in mapping are small areas of Flasher, Lihen, Parshall, and Telfer soils. These included soils make up about 15 to 20 percent of the unit. Flasher soils are shallow. They are on ridges. Lihen and Parshall soils are dark to a depth of more than 20 and 16 inches, respectively. They are in swales. Telfer soils are dark to a depth of 10 to 20 inches. They occur as areas intermingled with areas of the Seroco soil.

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

Most areas are used for range. This map unit generally is unsuited to cultivated crops and to grasses and legumes for pasture and hay because of droughtiness and soil blowing. Soil blowing is a severe hazard and water erosion a slight hazard.

The important range forage plants on this soil are prairie sandreed and needleandthread. Soil blowing and droughtiness are problems if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

The Seroco soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings, but the Blownout land generally is unsuited. The Seroco soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect seedlings from abrasion.

If buildings are constructed on the Seroco soil, the sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. Because of the rapid permeability, the soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the absorption fields and buildings so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification of the Seroco soil is VIIe, and that of the Blownout land is VIIIe. The range site of the Seroco soil is Thin Sands. The Blownout land is not assigned to a range site. The productivity index of the map unit for spring wheat is 0.

60—Shambo loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and alluvial fans in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface soil is loam about 13 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is loam about 29 inches thick. It is brown in the upper part, light olive brown in the next part, and pale brown in the lower part. The substratum to a depth of about 60 inches is light gray loam. In some places the soil is silt loam or fine sandy loam throughout. In other places the dark color of the surface layer extends to a depth of more than 16 inches. In some areas the substratum is gravelly sand.

Included with this soil in mapping are small areas of Amor, Daglum, and Grail soils. These soils make up about 10 percent of the unit. Amor soils have soft bedrock at a depth of 20 to 40 inches. They are on low ridges and knolls. Daglum and Grail soils are on foot slopes. Daglum soils have an alkali subsoil. Grail soils are dark to a depth of more than 16 inches and contain more clay than the Shambo soil.

Permeability is moderate in the Shambo soil, and runoff is slow. Available water capacity is high. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining tilth and the content of organic matter is the main management concern if cultivated crops are grown. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. A system of conservation tillage that leaves crop residue on the surface, stripcropping in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife.

The important range forage plants on this soil are western wheatgrass, needleandthread, and blue grama. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 85.

60B—Shambo loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and alluvial fans in the uplands. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface soil is loam about 13 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is loam about 29 inches thick. It is brown in the upper part, light olive brown in the next part, and pale brown in the lower part. The substratum to a depth of about 60 inches is light gray loam. In some places the soil is silt loam or fine sandy loam throughout. In other places the dark color of the surface layer extends to a depth of more than 16 inches.

Included with this soil in mapping are small areas of Amor, Daglum, and Grail soils. These soils make up about 10 percent of the unit. Amor soils have soft bedrock at a depth of 20 to 40 inches. They are on low ridges and knolls. Daglum and Grail soils are on foot slopes. Daglum soils have an alkali subsoil. Grail soils are dark to a depth of more than 16 inches and contain more clay than the Shambo soil.

Permeability is moderate in the Shambo soil, and runoff is medium. Available water capacity is high. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass, needleandthread, and blue grama. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The moderate permeability is a limitation in septic tank absorption fields, but it can be overcome by enlarging the field.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 81.

62B—Daglum Variant-Daglum loams, 1 to 6 percent slopes. These nearly level and gently sloping, alkali soils are on uplands that generally are dissected by shallow drainageways. The Daglum Variant soil is shallow and well drained, and the Daglum soil is moderately deep and moderately well drained. Individual areas are irregular in shape and range from about 5 to 150 acres in size. They are about 45 to 90 percent Daglum Variant soil and 5 to 30 percent Daglum soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Daglum Variant soil has a brown loam surface layer about 5 inches thick. The subsurface layer is pale brown loam about 3 inches thick. The subsoil is about 11 inches thick. It is dark yellowish brown clay in the upper part and light gray silty clay in the lower part. Below this is white shale bedrock. In a few places the bedrock is hard and is more than 20 inches below the surface.

Typically, the Daglum soil has a grayish brown loam surface layer about 6 inches thick. The subsurface layer is light brownish gray loam about 3 inches thick. The subsoil is about 25 inches thick. It is dark brown clay in the upper part, dark grayish brown silty clay in the next part, and light olive silty clay in the lower part. Below this is olive shale bedrock. In places the subsoil is at a depth as shallow as 5 inches.

Included with these soils in mapping are small areas of Amor and Belfield soils. These included soils make up about 5 to 25 percent of the unit. Amor soils are loam throughout and have soft bedrock at a depth of 20 to 40 inches. They are on slight rises. Belfield soils are deep and do not have a subsurface layer. They occur as areas intermingled with areas of the Daglum soil. Also included are small areas where flagstones cover 5 to 15 percent of the surface and a few moderately sloping and moderately steep areas.

Permeability is very slow in the Daglum Variant and Daglum soils, and runoff is medium. Available water capacity is very low in the Daglum Variant soil and low in the Daglum soil. Root penetration is restricted by the dense, alkali subsoil at a depth of about 8 inches in the Daglum Variant soil and 9 inches in the Daglum soil. Tilth is fair.

Most areas are used for cultivated crops. These soils are poorly suited to corn, flax, and small grain and to grasses and legumes for pasture and hay because of droughtiness, alkalinity, and the depth to bedrock. Soil blowing is a slight hazard and water erosion a moderate hazard. Controlling erosion and maintaining tilth are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface and stripcropping help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are western wheatgrass, green needlegrass, and blue grama. Crested wheatgrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. The dense, alkali subsoil, which restricts root penetration, and the salts, which reduce the amount of water available to plants, are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to protect the soil against erosion.

These soils are suited to only a few of the most drought and salt tolerant, climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Supplemental watering and control of the ground cover help to ensure the survival of seedlings. Individual trees and shrubs vary in height, density, and vigor because root development is restricted in the dense subsoil and the salts in the soil reduce the amount of available water.

These soils generally are unsuited to buildings and septic tank absorption fields because of the depth to bedrock and the very slow permeability. Better sites generally are nearby.

The land capability classification is IVs. The range site is Claypan. The productivity index for spring wheat is 33.

63—Straw loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on flood plains. It is subject to rare flooding. Individual areas are long and narrow and range from about 15 to more than 150 acres in size.

Typically, the surface soil is about 27 inches thick. It is dark grayish brown loam in the upper part, dark grayish brown clay loam in the next part, and grayish brown clay loam in the lower part. The upper part of the substratum is light yellowish brown and pale yellow loam. The next part is gray and dark gray clay loam. The lower part to a depth of about 60 inches is grayish brown loam. In some places the dark color of the surface layer extends to a depth of only 8 to 16 inches. In other places the surface soil and substratum are silty clay loam or silty clay.

Included with this soil in mapping are small areas of Banks soils. These soils make up about 10 percent of the unit. They are closer to the stream channels than the Straw soil. Also, they contain more sand and do not have a thick, dark surface layer. Also included are some areas of well drained soils that do not have a dark surface layer.

Permeability is moderate in the Straw soil, and runoff is slow. Available water capacity is high. The surface layer is friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining tilth and the content of organic matter is the main management concern if cultivated crops are grown. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. A system of conservation tillage that leaves crop residue on the surface helps to control erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife.

The important range forage plants on this soil are big bluestem, western wheatgrass, and green needlegrass. Crested wheatgrass, western wheatgrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. The soil supports scattered stands of eastern cottonwood, American elm, green ash, and common chokecherry, generally near the stream channels.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Better sites generally are nearby.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 92.

64—Straw loam, channeled. This deep, level and nearly level, well drained soil is on flood plains, mainly in narrow valleys that have steeply sloping sides. It is frequently flooded. Individual areas are long and narrow and range from about 20 to more than 50 acres in size. They are dissected into small, irregularly shaped tracts by meandering channels. Some areas are isolated by deep channels and steep escarpments.

Typically, the surface soil is about 27 inches thick. It is very dark grayish brown loam in the upper part, dark grayish brown clay loam in the next part, and grayish brown clay loam in the lower part. The upper part of the substratum is light yellowish brown and pale yellow loam. The next part is gray and dark gray clay loam. The lower part to a depth of about 60 inches is grayish brown loam. In places the dark color of the surface layer extends to a depth of only 8 to 16 inches.

Included with this soil in mapping are small areas of Cabba, Flasher, and Rhoades soils. These soils make up about 5 to 15 percent of the unit. Cabba and Flasher soils are shallow. They are on valley sides. Rhoades soils have an alkali subsoil. They are on foot slopes in the uplands.

Permeability is moderate in the Straw soil, and runoff is slow. Available water capacity is high.

Most areas are used for range. This soil generally is unsuited to cultivated crops and to grasses and legumes for pasture and hay because of the meandering channels and the small size of the tillable areas. Soil blowing and water erosion are slight hazards.

The important range forage plants on this soil are big bluestem, western wheatgrass, and green needlegrass. No major problems affect the use of this soil as range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Because of the deep channels and steep escarpments, however, the use of planting machinery is difficult. Many areas support a stand of eastern cottonwood, American elm, green ash, and common chokecherry.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Better sites generally are nearby.

The land capability classification is VIw. The range site is Overflow. The productivity index for spring wheat is 0.

65B—Parshall fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on terraces and on foot slopes and toe slopes in the uplands. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The subsoil is fine sandy loam about 24 inches thick. It is dark grayish brown in the upper part and light brownish gray in the lower part. The upper part of the substratum is light brownish gray sandy loam. The lower part to a depth of about 60 inches is light yellowish brown fine sandy loam. In some places the soil is loam throughout. In other places the dark color of the surface layer extends to a depth of only 8 to 16 inches.

Included with this soil in mapping are small areas of Regan and Vebar soils. These soils make up about 10 percent of the unit. Regan soils are poorly drained and are in narrow drainageways. Vebar soils have soft bedrock at a depth of 20 to 40 inches. They are on knolls and side slopes.

Permeability is moderately rapid in the Parshall soil, and runoff is slow. Available water capacity is moderate. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory upland wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are prairie sandreed and needleandthread. Crested wheatgrass, prairie sandreed, and sweetclover are suitable pasture and hay plants. Soil blowing and slight droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The soil is well suited to septic tank absorption fields.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 69.

68C—Telfer-Seroco loamy fine sands, 1 to 9 percent slopes. These deep, nearly level to moderately sloping, excessively drained soils are on uplands. The Telfer soil is on side slopes, and the Seroco soil is on ridges and knobs. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 55 to 75 percent Telfer soil and 20 to 40 percent Seroco soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Telfer soil has a very dark grayish brown loamy fine sand surface layer about 5 inches thick. The next layer is brown loamy sand about 6 inches thick. The upper part of the substratum is olive brown loamy sand. The lower part to a depth of about 60 inches is light olive brown fine sand. In some places the dark color of the surface layer extends to a depth of more than 20 inches. In other places the surface layer is fine sandy loam.

Typically, the Seroco soil has a dark grayish brown loamy fine sand surface layer about 7 inches thick. The upper part of the substratum is brown loamy sand. The lower part to a depth of about 60 inches is light olive brown loamy fine sand. In places the surface layer is fine sandy loam.

Included with these soils in mapping are small areas of Beisigl, Ekalaka, and Flasher soils. These included soils make up about 15 to 25 percent of the unit. Beisigl soils have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. Ekalaka soils have an alkali subsoil at a depth of 9 to 20 inches. They are on foot slopes. Flasher soils have soft sandstone bedrock within a depth of 20 inches. They are on ridges. Also included are a few areas of Blownout land.

Permeability is rapid in the Telfer and Seroco soils, and runoff is slow. Available water capacity is low.

Most areas are used for range, but some areas are used for cultivated crops. These soils generally are unsuited to cultivated crops and poorly suited to grasses and legumes for pasture and hay because of the hazards of soil blowing and drought. Soil blowing is a severe hazard and water erosion a slight hazard.

The important range forage plants on these soils are prairie sandreed and needleandthread. Soil blowing and droughtiness are problems if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

These soils are suited to some of the trees and shrubs grown as windbreaks and environmental plantings. The soils are droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity.

Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on these soils, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. Because of the rapid permeability, the soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution.

The land capability classification is VIe. The range site of the Telfer soil is Sands, and that of the Seroco soil is Thin Sands. The productivity index of the map unit for spring wheat is 0.

70B—Beisigl-Lihen-Flasher loamy fine sands, 1 to 6 percent slopes. These soils are on uplands that generally are dissected by many small drainageways. The moderately deep, somewhat excessively drained, nearly level and gently sloping Beisigl soil is on side slopes. The deep, well drained, nearly level Lihen soil is in swales. The shallow, somewhat excessively drained, gently sloping Flasher soil is on ridges. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 30 to 65 percent Beisigl soil, 10 to 35 percent Lihen soil, and 15 to 30 percent Flasher soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a grayish brown loamy fine sand surface layer about 6 inches thick. The subsoil is light yellowish brown loamy fine sand about 6 inches thick. The next layer is light yellowish brown fine sand about 9 inches thick. Below this is soft sandstone bedrock. In places the soil is fine sandy loam throughout.

Typically, the Lihen soil has a loamy fine sand surface soil about 14 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The next layer is dark grayish brown loamy fine sand about 13 inches thick. The substratum to a depth of about 60 inches is grayish brown loamy sand. In some places the dark color of the surface soil extends to a depth of only 10 to 20 inches. In other places the soil is fine sandy loam throughout.

Typically, the Flasher soil has a dark grayish brown loamy fine sand surface layer about 6 inches thick. The substratum is light olive brown loamy fine sand about 4 inches thick. Below this is soft sandstone bedrock.

Included with these soils in mapping are small areas of Seroco soils on knolls and hummocks. These included soils make up about 5 percent of the unit.

Permeability is rapid in the Beisigl and Lihen soils and moderately rapid in the Flasher soil. Runoff is slow on all three soils. Available water capacity is low in the Lihen soil and very low in the Beisigl and Flasher soils. Root penetration is restricted by the soft sandstone bedrock at a depth of about 21 inches in the Beisigl soil and 10 inches in the Flasher soil. Tilth is good in all three soils.

Most areas are used for range. These soils are poorly suited to corn, flax, and small grain and to grasses and legumes for pasture and hay because of soil blowing and droughtiness. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth, overcoming droughtiness, and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, windbreaks, and stripcropping help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. Rye and winter wheat can make the best use of early season moisture. Leaving tall stubble on the surface helps to trap snow and thus increases the moisture supply.

The important range forage plants on these soils are prairie sandreed, needleandthread, and little bluestem. Intermediate wheatgrass, crested wheatgrass, prairie sandreed, and sweetclover are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

The Beisigl and Lihen soils are suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Flasher soil generally is unsuited. The Beisigl and Lihen soils are droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low or very low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on the Beisigl and Lihen soils, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The depth to bedrock in the Beisigl and Flasher soils is a limitation on sites for buildings with basements. The rock generally is soft and can be easily excavated unless it has thin hard lenses.

Because of the rapid permeability, the Lihen and Beisigl soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. The effluent in septic tank absorption fields in the Beisigl and Flasher soils can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution.

The land capability classification of the Beisigl and Lihen soils is IVe, and that of the Flasher soil is VIe. The range site of the Beisigl and Lihen soils is Sands, and that of the Flasher soil is Shallow. The productivity index of the map unit for spring wheat is 35.

70D—Beisigl-Flasher loamy fine sands, 6 to 15 percent slopes. These moderately sloping and strongly sloping, somewhat excessively drained soils are on uplands that generally are dissected by many small drainageways. The moderately deep Beisigl soil is on side slopes, and the shallow Flasher soil is on ridges and hills. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 50 to 70 percent Beisigl soil and 20 to 40 percent Flasher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a grayish brown loamy fine sand surface layer about 6 inches thick. The subsoil is light yellowish brown loamy fine sand about 6 inches thick. The next layer is light yellowish brown fine sand about 9 inches thick. Below this is soft sandstone bedrock. In places the soil is fine sandy loam throughout.

Typically, the Flasher soil has a dark grayish brown loamy fine sand surface layer about 6 inches thick. The substratum is light olive brown loamy fine sand about 4 inches thick. Below this is soft sandstone bedrock. In places the soil is fine sandy loam throughout.

Included with these soils in mapping are small areas of Ekalaka, Lemert, Lihen, Parshall, Rhoades, and Seroco soils. These included soils make up about 5 to 15 percent of the unit. Ekalaka, Lemert, and Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes. Lihen and Parshall soils are deep and are dark to a depth of more than 16 and 20 inches, respectively. They are on foot slopes and toe slopes. Seroco soils are deep. They are on knobs and hummocks.

Permeability is rapid in the Beisigl soil and moderately rapid in the Flasher soil. Runoff is medium on both soils. Available water capacity is very low. Root penetration is restricted by the soft sandstone bedrock at a depth of about 21 inches in the Beisigl soil and 10 inches in the Flasher soil.

Most areas are used for range. These soils generally are unsuited to cultivated crops and to grasses and legumes for pasture and hay because of droughtiness and the slope. Soil blowing is a severe hazard and water erosion a moderate hazard.

The important range forage plants on these soils are prairie sandreed, needleandthread, and little bluestem. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

The Beisigl soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings, but the Flasher soil generally is unsuited. The Beisigl soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the very low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on these soils, the depth to bedrock is a limitation. The rock is generally soft and can be easily excavated unless it has thin hard lenses. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for waste disposal. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the absorption fields and buildings so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification is VIe. The range site of the Beisigl soil is Sands, and that of the Flasher soil is Shallow. The productivity index of the map unit for spring wheat is 0.

71B—Sen silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to about 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is silt loam about 20 inches thick. It is brown in the upper part, light yellowish brown in the next part, and light gray in the lower part. The substratum is light yellowish brown silt loam about 7 inches thick. Below this is soft siltstone bedrock. In some places lime is at a depth of 2 to 10 inches. In other places the soil is loam throughout.

Included with this soil in mapping are small areas of Arnegard, Cabba, Daglum, Grail, Moreau, and Rhoades soils. These soils make up about 5 to 15 percent of the unit. Arnegard and Grail soils are deep and are dark to a depth of more than 16 inches. They are on foot slopes. Cabba soils have soft bedrock at a depth of 10 to 20 inches. They are on ridges. Daglum and Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes. Moreau soils contain more clay than the Sen soil. They are on side slopes.

Permeability and available water capacity are moderate in the Sen soil. Runoff is medium. Root penetration is restricted by the siltstone bedrock at a depth of about 33 inches. The surface layer is friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a slight hazard and water erosion a moderate hazard. Maintaining tilth and controlling erosion are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and diversions help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are western wheatgrass, needleandthread, and blue grama. Crested wheatgrass, western wheatgrass, and sweetclover are suitable pasture and hay plants. Water erosion is a problem, especially if the range is overgrazed. Maintaining an adequate cover of the key plants helps to control erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for buildings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for absorption fields.

The land capability classification is IIe. The range site is Silty. The productivity index for spring wheat is 68.

80B—Vebar-Parshall fine sandy loams, 1 to 6 percent slopes. These nearly level and undulating, well drained soils are on uplands. The moderately deep Vebar soil is on side slopes, and the deep Parshall soil is on foot slopes and toe slopes. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 55 to 75 percent Vebar soil and 20 to 35 percent Parshall soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Vebar soil has a dark brown fine sandy loam surface layer about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. It is dark brown in the upper part and light olive brown in the lower part. The substratum is light olive brown sandy loam about 7 inches thick. Below this is sandstone bedrock. In places the soil is loam throughout.

Typically, the Parshall soil has a very dark grayish brown fine sandy loam surface layer about 9 inches thick. The subsoil is fine sandy loam about 24 inches thick. It is dark grayish brown in the upper part and light brownish gray in the lower part. The upper part of the substratum is light brownish gray sandy loam. The lower part to a depth of about 60 inches is light yellowish brown fine sandy loam. In places the soil is loam throughout.

Included with these soils in mapping are small areas of Flasher, Lihen, and Rhoades soils. These included soils make up about 10 to 15 percent of the unit. Flasher soils are shallow. They are on ridges. Lihen soils are deep and contain more sand than the Parshall soil. They are in swales. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderately rapid in the Vebar and Parshall soils, and runoff is slow. Available water capacity is low in the Vebar soil and moderate in the Parshall soil. Root penetration is restricted by the sandstone bedrock at a depth of about 31 inches in the Vebar soil. The surface layer of both soils is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. These soils are suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on these soils are prairie sandreed and needleandthread. Crested wheatgrass, prairie sandreed, and sweetclover are suitable pasture and hay plants. Soil blowing and droughtiness are problems if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

The Parshall soil is suited to all and the Vebar soil to many of the trees and shrubs grown as windbreaks and environmental plantings. The Vebar soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The depth to bedrock in the Vebar soil is a limitation on sites for buildings with basements. The rock is soft and can be easily excavated unless it has thin hard lenses. The effluent in septic tank absorption fields can follow bedding planes in the bedrock underlying the Vebar soil and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the Vebar soil tends to be deeper and where the Parshall soil is located, are better sites for waste disposal.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 61.

80C—Vebar fine sandy loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 5 to more than 50 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. It is dark brown in the upper part and light olive brown in the lower part. The substratum is light olive brown sandy loam about 7 inches thick. Below this is sandstone bedrock. In some places the bedrock is below a depth of 40 inches. In other places the dark color of the surface layer extends to a depth of more than 16 inches. In some areas the soil is loam throughout.

Included with this soil in mapping are small areas of Arnegard, Flasher, and Rhoades soils. These soils make up about 15 to 20 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Flasher soils have bedrock within a depth of 20 inches. They are on ridges. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderately rapid in the Vebar soil, and runoff is medium. Available water capacity is low. Root penetration is restricted by the sandstone bedrock at a depth of about 31 inches. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is poorly suited to corn, flax, and small grain and is suited to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a moderate hazard. Maintaining tilth and controlling soil blowing and water erosion are the major management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, windbreaks, stripcropping, and grassed waterways in areas where runoff concentrates help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory upland wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are prairie sandreed and needleandthread. Crested wheatgrass, prairie sandreed, and sweetclover are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings with basements are constructed on this soil, the depth to bedrock is a limitation. The rock is generally soft and can be easily excavated unless it has thin hard lenses. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal.

The land capability classification is IVe. The range site is Sandy. The productivity index for spring wheat is 48.

83D—Vebar fine sandy loam, 6 to 15 percent slopes, very stony. This moderately deep, moderately sloping and strongly sloping, well drained soil is on side slopes in the uplands. About 10 to 15 percent of the surface is covered with stones and boulders. Individual areas are irregular in shape and range from 10 to more than 50 acres in size.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. It is dark brown in the upper part and light olive brown in the lower part. The substratum is light olive brown sandy loam about 7 inches thick. Below this is sandstone bedrock. In some places the bedrock is below a depth of 40 inches. In other places the soil is loam throughout.

Included with this soil in mapping are small areas of Arnegard, Flasher, and Rhoades soils. These soils make up about 15 to 25 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Flasher soils have sandstone bedrock within a depth of 20 inches. They are on ridges. Rhoades soils have an alkali subsoil. They are on side slopes and foot slopes.

Permeability is moderately rapid in the Vebar soil, and runoff is medium. Available water capacity is low. Root penetration is restricted by the sandstone bedrock at a depth of about 31 inches.

Most areas are used for range. This soil generally is unsuited to cultivated crops, to grasses and legumes for pasture and hay, and to windbreaks and environmental plantings because of droughtiness and stoniness. Soil blowing is a slight hazard and water erosion a severe hazard.

The important range forage plants on this soil are prairie sandreed and needleandthread. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

If buildings with basements are constructed on this soil, the depth to bedrock is a limitation. The rock generally is soft and can be easily excavated unless it has thin hard lenses. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soil tends to be deeper, are better sites for waste disposal. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the absorption fields and buildings so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification is VIs. The range site is Sandy. The productivity index for spring wheat is 0.

84D—Vebar-Flasher complex, 6 to 15 percent slopes. These moderately sloping and strongly sloping soils are on uplands that generally are dissected by many small drainageways. The well drained, moderately deep Vebar soil is on side slopes, and the somewhat excessively drained, shallow Flasher soil is on hills and ridges. Individual areas are irregular in shape and range from 10 to more than 200 acres in size. They are about 65 to 75 percent Vebar soil and 20 to 30 percent Flasher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Vebar soil has a dark brown fine sandy loam surface layer about 6 inches thick. The subsoil is fine sandy loam about 18 inches thick. It is dark brown in the upper part and light olive brown in the lower part. The substratum is light olive brown sandy loam about 7 inches thick. Below this is sandstone bedrock. In some places the soil is loam or calcareous loamy fine sand throughout. In other places the bedrock is below a depth of 40 inches. In some areas the dark color of the surface layer extends to a depth of more than 16 inches.

Typically, the Flasher soil has a dark grayish brown loamy fine sand surface layer about 6 inches thick. The substratum is light olive brown loamy fine sand about 4 inches thick. Below this is soft sandstone bedrock. In places the soil is fine sandy loam throughout.

Included with these soils in mapping are small areas of Arnegard, Daglum, and Ekalaka soils. These included soils make up about 5 to 10 percent of the unit. Arnegard soils are deep and are dark to a depth of more than 16 inches. They are in swales. Daglum and Ekalaka soils are deep and have an alkali subsoil. Daglum soils are on foot slopes, and Ekalaka soils are on the lower side slopes.

Permeability is moderately rapid in the Vebar and Flasher soils, and runoff is medium. Available water capacity is low in the Vebar soil and very low in the Flasher soil. Root penetration is restricted by the sandstone bedrock at a depth of about 31 inches in the Vebar soil and 10 inches in the Flasher soil.

Most areas are used for range. These soils generally are unsuited to cultivated crops and to grasses and legumes for pasture and hay because of droughtiness and the slope. Soil blowing and water erosion are severe hazards.

The important range forage plants on these soils are prairie sandreed and needleandthread. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

The Vebar soil is suited to some of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Flasher soil generally is unsuited. The Vebar soil is droughty, and moisture stress commonly affects the trees and shrubs for short periods. Supplemental watering helps to ensure the survival of seedlings. Little benefit is derived from fallowing in the season prior to planting because of the low available water capacity. Strips of an annual cover crop between the rows of trees and shrubs help to control soil blowing and protect the seedlings from abrasion.

If buildings are constructed on this soil, the depth to bedrock is a limitation. The rock generally is soft and can be easily excavated unless it has thin hard lenses. The effluent in septic tank absorption fields can follow bedding planes in the bedrock and surface downslope or pollute ground water. A mound system helps to prevent this pollution. The lower parts of the landscape, where the soils tend to be deeper, are better sites for waste disposal. The slope is a limitation on sites for septic tank absorption fields and buildings, but designing the absorption fields and buildings so that they conform to the natural slope of the land helps to overcome this limitation.

The land capability classification is VIe. The range site of the Vebar soil is Sandy, and that of the Flasher soil is Shallow. The productivity index of the map unit for spring wheat is 0.

90—Velva fine sandy loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on low terraces and flood plains. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to more than 150 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 6 inches thick. The substratum extends to a depth of 60 inches or more. In sequence downward, it is brown fine sandy loam, grayish brown sandy loam, dark grayish brown fine sandy loam, grayish brown fine sandy loam, and grayish brown, stratified loam. In some places the dark color of the surface layer extends to a depth of more than 16 inches. In other places the soil is loam throughout.

Included with this soil in mapping are small areas of Banks and Rhoades soils. These soils make up about 15 to 20 percent of the unit. Banks soils contain more sand than the Velva soil. Also, they are nearer to the stream channels. Rhoades soils have an alkali subsoil. They are on foot slopes in the uplands.

Permeability is moderately rapid in the Velva soil, and runoff is slow. Available water capacity is high. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops (fig. 9). This soil is suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing is a severe hazard and water erosion a slight hazard. Maintaining tilth and controlling soil blowing are the main management concerns if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, field windbreaks, dikes, and diversions help to prevent excessive soil loss. Conservation tillage also helps to provide food and cover for resident and migratory upland wildlife. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth.

The important range forage plants on this soil are big bluestem, western wheatgrass, and green needlegrass. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. The soil supports scattered stands of eastern cottonwood, American elm, green ash, and common chokecherry, generally adjacent to the stream channels.

This soil generally is unsuited to buildings and septic tank absorption fields because of the flooding. Better sites generally are nearby.

The land capability classification is IIIe. The range site is Sandy. The productivity index for spring wheat is 68.

91F—Schaller-Cabba complex, 3 to 45 percent slopes. These gently sloping to very steep soils are on terraces and on shoulder slopes in the uplands. Most areas are dissected by short, entrenched drainageways. The Schaller soil is deep and excessively drained, and the Cabba soil is shallow and well drained. Individual areas are long and narrow or irregularly shaped and range from 10 to more than 100 acres in size. They are about 45 to 65 percent Schaller soil and 10 to 30 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Schaller soil has a dark brown fine sandy loam surface layer about 9 inches thick. The subsoil is grayish brown fine sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is light yellowish brown gravelly coarse sand. In a few places the surface layer is more than 20 inches thick.

Typically, the Cabba soil has a grayish brown loam surface layer about 3 inches thick. The next layer is light brownish gray silt loam about 3 inches thick. The substratum is light gray silty loam about 4 inches thick. Below this is soft siltstone bedrock. In some places the soil contains more sand throughout. In other places it is silty clay. In a few places the surface soil is 12 to 18 inches thick.

Included with these soils in mapping are small areas of Amor, Arnegard, Bowdle, Lihen, Parshall, Rhoades, and Vebar soils. These included soils make up about 15 to 25 percent of the unit. Amor and Vebar soils are moderately deep. They are on side slopes. Arnegard and Parshall soils are deep. Arnegard soils typically have a loam subsoil. Parshall soils typically have a fine sandy loam subsoil and a substratum of sandy loam and fine sandy loam. Bowdle soils have a loam surface layer, a subsoil of loam and sandy loam, and a sandy substratum. They are higher on the landscape than the Schaller and Cabba soils. Lihen soils have a loamy fine sand surface layer and a loamy sand substratum. They

Figure 9.—An area of Velva fine sandy loam, 0 to 3 percent slopes, used as cropland.

are on foot slopes. Rhoades soils have an alkali subsoil. They are on the lower side slopes and on foot slopes.

Permeability is very rapid in the Schaller soil and moderate in the Cabba soil. Runoff is rapid on the Schaller soil and very rapid on the Cabba soil. Available water capacity is very low in both soils. Root penetration is restricted by the sand and gravel at a depth of about 15 inches in the Schaller soil and by the soft bedrock at a depth of about 10 inches in the Cabba soil.

Most areas are used for range. These soils generally are unsuited to cultivated crops and to the trees and shrubs grown as windbreaks and environmental plantings because of droughtiness and the slope. Soil blowing and water erosion are severe hazards.

The important range forage plants on these soils are little bluestem, needleandthread, western wheatgrass, and prairie sandreed. Soil blowing and droughtiness are problems, especially if the range is overgrazed. Reestablishing vegetation is difficult in denuded areas. Maintaining an adequate cover of the key plants at a height that traps snow helps to store water in the soil, helps to control soil blowing, prevents denuding, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

These soils generally are unsuited to buildings and septic tank absorption fields because of the slope of both soils and the shallow depth to bedrock in the Cabba soil. Better sites generally are nearby.

The land capability classification is VIIe. The range site of the Schaller soil is Very Shallow, and that of the Cabba soil is Shallow. The productivity index of the map unit for spring wheat is 0.

101—Brisbane loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in convex areas on broad drainage divides in the uplands. Individual areas are irregular in shape and range from 25 to more than 2,000 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 25 inches thick. It is 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 strong brown and dark yellowish brown sand. In some places the soil is fine sandy loam throughout. In other places soft sandstone bedrock is at a depth of 40 to 60 inches. In some areas the surface layer is clay loam. In other areas the dark color of the surface layer extends to a depth of only 8 to 16 inches.

Included with this soil in mapping are small areas of Daglum, Flasher, and Grail soils. These soils make up about 5 to 25 percent of the unit. Daglum soils have an alkali subsoil. They are in swales. Flasher soils have sandstone bedrock within a depth of 20 inches. They are generally on low ridges, in areas where rock fragments are on the surface. Grail soils are deep and have a clay loam and loam substratum. They are in swales.

Permeability is moderate in the upper part of the Brisbane soil and rapid in the lower part. Runoff is slow. Available water capacity is moderate. The surface layer is very friable and can be easily tilled. Tilth is good.

Most areas are used for cultivated crops. This soil is well suited to corn, flax, and small grain and to grasses and legumes for pasture and hay. Soil blowing and water erosion are slight hazards. Maintaining tilth and the organic matter content is the main management concern if cultivated crops are grown. Returning crop residue to the soil or adding other organic material improves fertility, increases the rate of water infiltration, and helps to maintain tilth. A system of conservation tillage that leaves crop residue on the surface and grassed waterways in areas where runoff concentrates help to control erosion. Conservation tillage also helps to provide food and cover for resident upland wildlife.

The important range forage plants on this soil are western wheatgrass, blue grama, and needleandthread. Crested wheatgrass, green needlegrass, and alfalfa are suitable pasture and hay plants. No major problems affect the use of this soil for range. Maintaining an adequate cover of the key plants helps to protect the soil against erosion, provides food and cover for rangeland wildlife, and permits regrowth of browse plants.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect the trees and shrubs. Eliminating grasses and weeds before the trees and shrubs are planted and controlling the regrowth of this ground cover improve the survival and growth rates of the trees and shrubs.

If buildings are constructed on this soil, the shrink-swell potential is a limitation, but installing a surface and foundation drainage system and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored. Because of the rapid permeability, the soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. A mound system helps to prevent this pollution.

The land capability classification is IIc. The range site is Silty. The productivity index for spring wheat is 78.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 63,000 acres in the survey area, or nearly 6 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county. Most of the prime farmland is used for crops, mainly small grain.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the requirements for prime farmland are:

6 Arnegard loam, 1 to 3 percent slopes

6B Arnegard loam, 3 to 6 percent slopes
35 Grail silty clay loam, 1 to 3 percent slopes

63 Straw loam, 0 to 3 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

Prepared by Lyle Samson, agronomist, and Steve R. Hausauer, district conservationist, Soil Conservation Service.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 40 percent of Grant County is cultivated. In 1981, about 210,800 acres were used for close-grown crops, 46,600 acres for row crops, and 108,000 acres for forage crops (*8*). During the period 1977 to 1981, the acreage used for close-grown crops averaged 196,900 acres per year. The acreage of summer fallow was 111,000 in 1980, 95,000 in 1981, and 125,000 in 1982. The acreage used for sunflowers is increasing. It averaged 15,700 acres per year from 1977 to 1981. It was 19,000 acres in 1981 and 35,000 acres in 1982. The acreage used for corn and forage has been stable in recent years. In 1982, the acreages of the principal close-grown crops were as follows: spring wheat, 116,000 acres; durum wheat, 10,000 acres; winter wheat, 3,000 acres; barley, 14,000 acres; oats, 46,500 acres; rye, 2,400 acres; and flax, 2,400 acres. The main row crops were sunflowers and corn. Sunflowers were grown on 35,000 acres, corn for grain on 2,500 acres, and corn for silage on 20,700 acres. Alfalfa was grown on 52,000 acres and other hay crops on 48,000 acres. Small acreages were planted to mustard, buckwheat, sorghum, millet, and safflower. About 4,700 acres are irrigated.

The potential of the soils in Grant County for increased production of food and fiber is good. This production is steadily increasing as the latest crop production technology is applied. This soil survey can facilitate the application of this technology.

The soils and climate of the county are suited to most of the crops that are commonly grown in the survey area. Crops that are not commonly grown but are suitable include dry edible beans, potatoes, and rapeseed.

The principal management measures that help to ensure continuing productivity are those that control soil blowing and water erosion, maintain or improve fertility and tilth, and result in proper utilization of soil moisture.

Water erosion and soil blowing reduce the productivity of the soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result, applications of fertilizer are needed to maintain adequate crop production. Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to both soil blowing and water erosion.

Soil blowing is a hazard on most of the soils in Grant County. It is a severe hazard on the coarse textured and moderately coarse textured soils, including Arveson, Beisigl, Breien, Desart, Ekalaka, Flasher, Lemert, Lihen, Parshall, Ruso, Seroco, Telfer, Vebar, and Velva soils.

Cabba, Chama, Moreau, Regan, and other soils that have a relatively high content of lime are susceptible to soil blowing in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure breaks down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by soil blowing if they are bare.

Water erosion is a severe hazard on moderately sloping and steeper soils, such as Amor, Cabba, Chama, Moreau, and Regent. It also is a severe hazard on Savage and other soils having slopes that are gentle but long. The hazard is greatest when the surface is bare.

Conservation practices that control both soil blowing and water erosion are those that maintain a protective cover on the surface. Examples are conservation tillage systems that keep a protective amount of crop residue on the surface. Applications of herbicides can help to eliminate the need for summer fallow tillage. Cover crops are also effective in controlling both soil blowing and water erosion. Field windbreaks, annual wind barriers, and stripcropping help to control soil blowing. Inclusion of grasses and legumes in the cropping sequence, grassed waterways, diversions, terraces, contour farming, and field stripcropping across the slope help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Moisture at planting time is critical to the success of the crop during the growing season. In years when the amount of available soil moisture is low at planting time, crop success for the year is greatly reduced. Measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds conserve moisture. Examples are stubble mulch; mulch tillage; no-till; stripcropping (fig. 10); cover crops; crop residue management; standing stubble, which traps snow; and applications of fertilizer. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to guard against moisture loss and erosion. Weed control helps to prevent depletion of the moisture supply.

Measures that improve fertility are needed on many soils. Examples are applications of commercial fertilizer or barnyard manure, green manure crops, and inclusion of legumes in the cropping sequence.

Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the soils that have a surface layer of silty clay loam, clay loam, or silty clay. Grail, Lawther, Moreau, Regent, and Savage soils are examples. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean tillage contributes to the loss of organic matter because it increases the susceptibility to water erosion and soil blowing. Studies in Grant County indicate that the content of organic matter and nitrogen is higher on stubble-mulched fields than on fields tilled in the conventional manner (*5*).

Management of Saline and Alkali Soils

Saline and alkali soils make up about 13 percent of Grant County. Saline soils make up 1 percent, or about 10,000 acres; alkali soils make up 10.6 percent, or about 114,000 acres; and saline-alkali soils make up 1.4 percent, or about 15,000 acres. Saline seeps affect about 1,000 acres in the county.

Saline soils have a high content of soluble salts, or salts that dissolve in water. The only saline soil in Grant County is Regan clay loam, 0 to 3 percent slopes. Saline seeps are areas of nonirrigated soils where salinity has recently developed. They are basically low-volume springs. The term "saline seep" distinguishes these recently developed saline soils from residual saline soils of preagricultural origin (*6*). A local term for saline soils is "white alkali."

Saline seeps generally develop in areas of restricted drainage. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is minimized by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface. Residual saline soils, such as the Regan soil, generally form in areas adjacent to natural sloughs and waterways. Saline seeps, on the other hand, commonly develop on the upper slopes. Typically, they develop when precipitation moves through the soil and dissolves salts. The salt-laden water that is not used by crops moves downward through the soil until it reaches an impermeable layer that impedes its progress. It then flows laterally until it discharges in areas where the water table is at or near the surface. As a result, salts are concentrated at or near the surface.

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are

Figure 10.—Stripcropping in an area of Amor and Vebar soils.

toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis is needed to determine the actual degree of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can be used for salt-tolerant crops and forage. Barley is the most salt tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established.

Saline seeps can be controlled by measures that reduce or prevent the flow of soil water from the contributing area to the seep area. The best measures are growing deep-rooted crops, such as alfalfa and sunflowers, and eliminating or minimizing fallow in the contributing area (*6*). The extent of summer fallow can be reduced by a "flex-cropping" system, in which planting decisions are based on the amount of stored soil moisture (*17*). If the amount is adequate at planting time, a crop is planted. Thus, the land is fallowed only in years when the amount of moisture is inadequate at planting time. Barriers that trap snow increase the supply of soil moisture at planting time in the spring and thus help to eliminate the need for fallow. Drainage of saline seeps generally is not feasible in Grant County because disposal of the salty water is a problem (*17*).

Alkali soils are characterized by a high content of exchangeable sodium, which adheres to the clay particles in the soil. The alkali soils in Grant County are Belfield, Daglum, Daglum Variant, Rhoades, Desart, Ekalaka, and Lemert. Locally, alkali soils are known as "black-alkali," "slick spots," "pan spots," or "gumbo."

Alkali soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the alkali soils and the surrounding soils that have normal physical properties is only a few feet, perhaps 5 to 10 feet.

Alkali soils develop in areas of saline soils that contain large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, rain gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, alkali subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. An example of soils that have a dense, alkali subsoil are the Daglum and Rhoades soils.

As the leaching by soil water continues, the sodium is gradually moved lower in the soil profile and eventually is carried below the rooting depth. The result is a more manageable soil, such as Belfield. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonalkali soil, such as Grail. This change requires a long period, usually centuries (*7*).

If plowed, alkali soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by the depth to the dense subsoil.

Identification of alkali soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of alkalinity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and stages of development. If the level of alkalinity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, the stage of crop growth, and the soil moisture status. A measure of the effect of alkalinity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the vegetative growth of these crops.

The variability of alkali soils can cause management problems. The alkali soils that have salts within a depth of 16 inches, such as Lemert and Rhoades soils, are generally best suited to native grasses. The soils that have a dense, alkali subsoil near the surface are generally unsuited to small grain and sunflowers.

Timely tillage is an important management need in areas of the leached alkali soils, such as Belfield loam. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soil puddles and crusts. If the soil is tilled when too dry, tillage and seeding implements cannot easily penetrate the soil. Deep plowing and chemical amendments can help to reclaim alkali soils, but they may not be feasible. To be effective, deep tillage should reach to the alkali subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of alkali soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-alkali soils develop in areas of restricted drainage where salts rise with the water table but where some downward leaching of clay and some saturation with sodium are evident and a dense, alkali subsoil has formed. The saline-alkali soils in Grant County are Harriet and Heil. The management needs and crop responses on these soils are a combination of those on saline soils and those on alkali soils.

Additional information about management or reclamation of saline and alkali soils is available from the Soil Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension 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.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Productivity Index

The productivity index is a relative rating of the ability of a particular map unit to produce a particular crop yield in comparison to other map units. The index ranges from 0, which indicates no yield, to 100, which indicates the highest yield. When the index is calculated, the similar and contrasting inclusions are considered as well as the soils specified in the name of the map unit.

In Grant County a productivity index of 100 was considered equal to an average annual yield of 32 bushels per acre of spring wheat. Multiplying the productivity index by 32 and then dividing the product by 100 will convert the index number to a figure representing the expected average annual yield per acre. Shambo loam, 1 to 3 percent slopes, for example, has a productivity index of 85, which when multiplied by 32 and then divided by 100, converts to 27, which is the expected annual yield of spring wheat in bushels per acre for this map unit. (See table 5.)

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*15*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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 miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Prepared by Brian Gerbig, range conservationist, Soil Conservation Service.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

The native vegetation on rangeland consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. Generally, the plants are suitable for grazing and the plant cover is sufficiently productive to justify grazing. Cultural treatments generally are not used to increase forage production. The composition and production of the plant community are determined by soil, climate, topography, overstory canopy, and grazing management.

In 1983, approximately 517,000 acres in Grant County, or about 48 percent of the total acreage, was rangeland. In areas where it is properly managed, this rangeland is similar to the presettlement prairie of the late 1800's and early 1900's. Most of the rangeland is on loamy uplands and terraces (fig. 11). Much of it occurs as nearly level to rolling soils that have an alkali subsoil and steep soils that are shallow or moderately deep over bedrock. The soils are generally unsuited or poorly suited to cultivated crops.

Most of the ranches include a cow-calf operation. A number also include a yearling operation, which adds flexibility during periods of low or high forage production. On some ranches used for a cow-calf operation, sheep are raised for improved income stability. In 1983, the farms and ranches in the county had about 76,000 head of cattle. Of that number, about 4,100 were milk cows (*8*).

Because of the relatively short growing season, many farmers and ranchers have established cool-season tame pastures to supplement the forage produced on rangeland and to extend the grazing season in the spring and fall. Droughts of short duration are common. As a result, cool-season pastures cannot be grazed in the fall in many years. Generally, large amounts of hay and feed are needed because of the long winters. Hay was harvested on about 100,000 acres in 1982 (*8*).

Range Site and Condition Classes

Soils vary in their capacity to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

Each range site has a distinctive potential plant community that is referred to as the climax vegetation. The climax vegetation is relatively stable and indicates what the range site is capable of producing. It reproduces itself annually and changes very little as long as the environment remains unchanged. On the prairie the climax vegetation consists of the kinds of plants that grew when the region was settled. It is generally the most productive combination of forage plants that can be grown on the site. When the site is grazed, some of the climax vegetation decreases in extent and some of it increases. Also, other plants invade the site.

Decreaser plants are the species that decline in quantity under close, continuous grazing. They generally are the tallest and most productive grasses and forbs and are the most palatable to livestock.

Increaser plants are the species that increase in quantity under close grazing at the expense of the decreaser species. They generally are the shorter plants or the ones less palatable to livestock.

Invader plants are species normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site only after the extent of the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Figure 11.—An area of Vebar and Parshall soils used as range. Flasher soils are in the background.

Range condition classes indicate the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the climax. *Excellent* indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; *good*, 51 to 75 percent; *fair*, 26 to 50 percent; and *poor*, 25 percent or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition and the moisture available to the plants during the growing season.

Table 6 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. 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. Range condition is an ecological rating only.

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 optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good range management keeps the range in excellent or good condition. Water is conserved, yields are improved, and soils are protected. The main management concern is recognizing the changes in the plant community that take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition, when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland has the ability to recover from prolonged overuse if the climax decreaser species have not been completely grazed out. If overgrazing is stopped, enough climax plants generally remain for proper grazing use, deferred grazing, and the grazing system to restore the rangeland to an excellent condition. In areas where the climax plant community has been destroyed, range seeding can improve the condition. Seeding the proper climax species also can restore productive rangeland in areas of poor-quality cropland. Brush control, development of watering facilities, and other mechanical practices are needed to improve the potential of some rangeland. Fencing is one of the most overlooked means of improving rangeland.

The following paragraphs describe the range sites in Grant County. The names of these sites are Clayey, Claypan, Closed Depression, Overflow, Saline Lowland, Sands, Sandy, Sandy Claypan, Shallow, Silty, Subirrigated, Thin Claypan, Thin Sands, and Very Shallow.

Clayey range site. This site is dominated by a mixture of cool-season, mid grasses and an understory of short grasses. The principal species are western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. The understory plants are blue grama, inland saltgrass, buffalograss, Pennsylvania sedge, and other upland sedges. Forbs, such as western yarrow, scarlet globemallow, prairie coneflower, and prairie thermopsis, make up about 5 percent of the total herbage. The common woody plants are fringed sagebrush, western snowberry, and prairie rose.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, low-quality forbs, and fringed sagewort.

Very few problems affect management of this site. The water infiltration rate is slow. As a result, an adequate cover of vegetation is needed to help ensure that forage production is not reduced by runoff. Areas where the range is in poor or fair condition can generally be restored to good or excellent condition by good management of the remnant climax species.

Claypan range site. The vegetation on this site is primarily a mixture of short and mid grasses, sedges, and forbs. The principal species are western wheatgrass, green needlegrass, and prairie junegrass. Other species are Sandberg bluegrass, plains reedgrass, blue grama, and upland sedges. The common forbs are scarlet globemallow, prairie thermopsis, and western yarrow. The site has only minor amounts of woody species.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and plains reedgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, and unpalatable forbs.

This site is easily damaged by overgrazing. Because of a dense subsoil and the content of salts in the soil, reestablishing vegetation is difficult in denuded areas. Careful management that maintains an abundance of the key plants is the best way to maintain forage production and protect the soil against water erosion.

Closed Depression range site. Mid grasses dominate this site. The principal species are western wheatgrass and prairie cordgrass. Other species are fowl bluegrass, foxtail barley, inland saltgrass, and common spikesedge. Forbs, such as curled dock and povertyweed, make up about 15 percent of the total herbage. The site has minor amounts of annual forbs.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie cordgrass, common spikesedge, and slender wheatgrass. The plants that increase in abundance under these conditions are western wheatgrass, inland saltgrass, foxtail barley, Kentucky bluegrass, and needle spikesedge. Further deterioration results in a dominance of fowl bluegrass, foxtail barley, inland saltgrass, and unpalatable forbs.

This site is easily damaged by overgrazing. Livestock are attracted to this site because of the supply of moisture. As a result, this site is frequently overgrazed and damaged by trampling. A properly designed grazing system can restore the climax vegetation to its potential.

Overflow range site. Both tall and mid grasses are dominant when this site is in excellent condition. The principal species are big bluestem, green needlegrass, western wheatgrass, and needleandthread. Other species are porcupinegrass, bearded wheatgrass, thickspike wheatgrass, Pennsylvania sedge, fescue sedge, little bluestem, and Kentucky bluegrass. Several forbs, such as Missouri goldenrod and tall white aster, make up about 10 percent of the total herbage. Several woody plants, such as western snowberry, prairie rose, common chokecherry, buffaloberry, and green ash, commonly grow on the site, depending on the position on the landscape. In some areas they make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, green needlegrass, prairie dropseed, and little bluestem. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, fescue sedge, and Kentucky bluegrass. Further deterioration results in a dominance of blue grama, sedges, and unpalatable forbs.

Because of its position on the landscape, this site is frequently overgrazed. Fencing generally is not feasible because of the small size or the shape of areas of this site. As a result of flooding and the runoff received by these areas, this is a very productive site when properly managed. A planned grazing system can restore the site and maintain a high level of productivity. Reseeding is needed in areas that have been farmed. In areas where shrubs dominate, brush control can help to restore productivity.

Saline Lowland range site. Salt-tolerant, mid grasses dominate this site. The principal species are Nuttall alkaligrass, inland saltgrass, alkali cordgrass, and salt-tolerant species of western wheatgrass and slender wheatgrass. Other species are alkali muhly, foxtail barley, mat muhly, and prairie bulrush. Forbs, such as silverweed cinquefoil and Pursh seepweed, make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, and alkali cordgrass. The plants that increase in abundance under these conditions are western wheatgrass, inland saltgrass, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, mat muhly, and unpalatable forbs, such as silverweed cinquefoil and dock.

A high content of salts and a restricted available water capacity limit forage production on this site. Careful management of the adapted salt-tolerant plants can maintain good forage production. If the plant community has been severely damaged, however, the site recovers slowly. Soil blowing and water erosion are hazards in denuded areas. Stock water ponds on this site frequently contain salty water. If feasible, alternative water sources should be developed.

Sands range site. The principal grasses on this site are prairie sandreed, needleandthread, sand bluestem, and little bluestem. Other species are blue grama, prairie junegrass, sand dropseed, western wheatgrass, and upland sedges. Forbs make up about 10 percent of the total herbage. This site has a small amount of woody species, such as prairie rose, western snowberry, and leadplant amorpha.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, little bluestem, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, upland sedges, and several forbs. Further deterioration results in a dominance of blue grama, Pennsylvania sedge, threadleaf sedge, sun sedge, and unpalatable forbs, such as green sagewort, fringed sagewort, and gray sagewort.

A low or very low available water capacity and the hazard of soil blowing are concerns in managing this site. Measures that minimize the formation of livestock trails and that do not allow the animals to concentrate in an area for too long a time are needed. In severely overgrazed areas, blowouts are common. On large blowouts, shaping, seeding, and mulching are needed before the climax vegetation can be reestablished. The vegetation in areas where the site is in fair or poor condition responds rapidly to improved grazing management.

Sandy range site. The principal grasses on this site are needleandthread and prairie sandreed. Other species are prairie junegrass, blue grama, western wheatgrass, green needlegrass, and upland sedges. The site generally has a number of early season forbs, such as western yarrow and silverleaf scurfpea. Woody plants, such as western snowberry and leadplant amorpha, make up about 5 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase in abundance under these conditions are blue grama, upland sedges, sand dropseed, and several forbs. Further deterioration results in a dominance of blue grama, Pennsylvania sedge, threadleaf sedge, sun sedge, and unpalatable forbs, such as western yarrow, green sagewort, and gray sagewort.

A low or moderate available water capacity is a concern in managing this site. Also, soil blowing is a hazard in denuded areas. Management that maintains the abundance of the key species results in a natural plant community that provides excellent forage for livestock and a protective plant cover.

Sandy Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, needleandthread, and blue grama. Other species are sun sedge, other upland sedges, and a small number of perennial forbs. The common woody plants are silver sagebrush, fringed sagebrush, and western snowberry.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass and needleandthread. The plants that increase in abundance under these conditions are blue grama, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagebrush, annual forbs, and annual grasses.

Forage production varies on this site. The soils have a dense, alkali subsoil and a limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover is needed to control erosion.

Shallow range site. A mixture of cool- and warm-season, mid grasses dominates this site. The principal species are western wheatgrass, needleandthread, little bluestem, and prairie sandreed. Other species are plains muhly, blue grama, sideoats grama, threadleaf sedge, and Pennsylvania sedge. The percentage of wheatgrass is generally somewhat higher on the medium textured soils, and the percentage of prairie sandreed is generally higher on the coarse textured soils. Forbs make up about 10 percent of the total herbage. The site has only a small amount of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as little bluestem, needleandthread, sideoats grama, and prairie sandreed. The plants that increase in abundance under these conditions are blue grama, western wheatgrass, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, unpalatable forbs, and fringed sagewort.

Because of a limited available water capacity, forage production is limited on this site. It varies, depending on rainfall patterns. The site is fragile, and the plant community can deteriorate rapidly if poor management results in severe erosion. Management that keeps the plant community near its potential helps to control erosion and results in the best use of the available water.

Silty range site. Mid grasses dominate this site. The principal species are western wheatgrass, needleandthread, green needlegrass, and prairie junegrass. Other species are blue grama, Pennsylvania sedge, threadleaf sedge, needleleaf sedge, and red threeawn. Forbs make up about 10 percent of the total herbage. The site has minor amounts of woody species.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and porcupinegrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, Pennsylvania sedge, threadleaf sedge, needleleaf sedge, and red threeawn. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, and varying amounts of fringed sage, green sagewort, gray sagewort, and other forbs.

Generally, no major problems affect management of this site. In the sloping areas, however, gullies can form along livestock trails. Fencing and improved grazing management help to prevent gullying. They are also beneficial in areas where gullies have already formed. Areas where the site is in poor or fair condition generally can be restored to good or excellent condition by good management. In some areas brush control is needed.

Subirrigated range site. Tall grasses dominate this site. The principal species are big bluestem, switchgrass, prairie cordgrass, little bluestem, and northern reedgrass. Other species are indiangrass, western wheatgrass, tall dropseed, slender wheatgrass, and Kentucky bluegrass. The site has minor amounts of sedges and rushes. A variety of forbs makes up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as big bluestem, switchgrass, prairie cordgrass, northern reedgrass, indiangrass, and little bluestem. The plants that increase in abundance under these conditions are mat muhly, fowl bluegrass, Kentucky bluegrass, Baltic rush, common spikerush, and undesirable forbs. Further deterioration results in a dominance of short grasses and grasslike plants and of undesirable forbs.

Because of the high percentage of warm-season grasses, this site can provide high-quality forage late in the growing season. In areas where the plant community has deteriorated from its potential, deferment of grazing during the growing season or a planned grazing system can restore the site. In areas where the potential plant community has been destroyed by cultivation or by extremely severe overuse, range seeding can reestablish the major grass species.

Thin Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, blue grama, prairie junegrass, and Sandberg bluegrass. Other species are inland saltgrass, tumblegrass, buffalograss, and Pennsylvania sedge and other upland sedges. Forbs make up about 5 percent of the total herbage. The common woody plants are fringed sagebrush, broom snakeweed, and cactus.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as western wheatgrass, prairie junegrass, and needleandthread. Plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of short grasses, sedges, fringed sagebrush, broom snakeweed, and undesirable forbs.

Because of a high content of salts near the surface, productivity is quite low on this site. The site produces good-quality forage for cattle only if properly managed. If the site is in poor or fair condition, recovery is quite slow because of the salts and a dense, alkali subsoil. Stock water pits should not be constructed on this site because the water is likely to be salty. Careful management can maintain or restore the site to good or excellent condition. If the vegetation has been destroyed by cultivation or the site denuded, range seeding can restore the climax vegetation. Good seeding techniques are needed.

Thin Sands range site. Mid grasses dominate this site. The principal species are prairie sandreed, needleandthread, and sand dropseed. Other species are blue grama, hairy grama, Pennsylvania sedge, threadleaf sedge, and sand bluestem. Forbs make up about 10 percent of the total herbage. The site has minor amounts of woody plants.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as prairie sandreed, needleandthread, and sand bluestem. The plants that increase in abundance under these conditions are Pennsylvania sedge, threadleaf sedge, blue grama, and hairy grama. Further deterioration results in a dominance of dryland sedges, blue grama, and several unpalatable forbs.

This site is very fragile and is subject to soil blowing if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in overgrazed areas. Good management can keep the site in good or excellent condition. In areas where the site is in poor or fair condition, careful management can restore productivity. A planned grazing system that includes adequate rest periods between the grazing periods is one of the better ways to manage this site.

Very Shallow range site. The site has a mixture of cool- and warm-season, mid grasses. Forage production is much lower than that on the Shallow range site. The principal species are needleandthread, western wheatgrass, little bluestem, blue grama, and plains muhly. Other species are prairie junegrass, red threeawn, sideoats grama, and upland sedges. Forbs and woody plants make up about 10 percent of the total herbage.

Continual heavy grazing by cattle results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, little bluestem, sideoats grama, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, Sandberg bluegrass, and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and undesirable forbs and shrubs.

Available water capacity is very low on this site. Also, water erosion is a hazard in the sloping areas. Gullies can readily form along cattle trails and in denuded areas. The site is frequently overgrazed. Once it is in fair or poor condition, it recovers slowly because of the very low available water capacity. Productivity can be maintained by careful management of the cool-season, mid grasses and by cross fencing, which helps to control livestock traffic patterns.

Woodland, Windbreaks, and Environmental Plantings

Prepared by Bruce C. Wight, forester, Soil Conservation Service.

Grant County has about 2,900 acres of native woodland (*9*). Most of the native woodland is near the major streams. It is on upland side slopes and the bottom land along the Heart River, the Cannonball River, Cedar Creek, Antelope Creek, and Snake Creek. The major soils on the wooded uplands include Vebar fine sandy loam, Parshall fine sandy loam, Amor loam, and Arnegard loam. The major soils on the wooded bottom land are Straw loam, Velva fine sandy loam, and Banks loam.

The chief forest species are American elm, plains cottonwood, and green ash on the bottom land along the Heart River and Antelope Creek and American elm, plains cottonwood, green ash, and boxelder on the bottom land along the Cannonball River and Snake and Cedar Creeks.

The chief upland forest species are American elm and green ash. Bur oak and quaking aspen grow along the Heart River and Antelope Creek. Bur oak does not grow along the Cannonball River or along Snake and Cedar Creeks, but boxelder is common. Other trees and shrubs include American plum, common chokecherry, hawthorn, silver buffaloberry, western snowberry, and woods rose.

The early settlers used the trees for fuel, lumber, and fenceposts. There is currently a renewed interest in using trees for fuel, but the principal uses are for protection from the wind and beautification.

Windbreaks have been planted in Grant County since the early days of settlement. Most of the early plantings were used to protect farmsteads and livestock. Since the late 1930's, more than 2,700,000 trees have been planted on about 4,200 acres by county farmers, who were assisted by the Soil Conservation Service and the Grant County Soil Conservation District. Tree planting is still needed around numerous farmsteads, but the major need is for windbreaks to prevent excessive soil loss on soils that are highly susceptible to soil blowing.

The following items should be considered before the trees and shrubs are planted: (1) the purpose of the planting, (2) the suitability of the soils to the various species of trees and shrubs, (3) the location and design of the windbreak, and (4) selection of a source of hardy and adapted trees and shrubs. If these items are not considered, a poor or unsuccessful windbreak may result.

The establishment of a windbreak or an environmental planting and the growth rate of the trees and shrubs also depend on suitable site preparation and adequate maintenance measures after the trees and shrubs are planted. Grass and weeds should be eliminated before planting, and any regrowth of the ground cover should be controlled for the life of the planting. Some replanting of seedlings may be necessary during the first 2 years.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Prepared by Erling Podoll, biologist, Soil Conservation Service.

Areas developed for public outdoor recreation meet most of the needs in Grant County. The major recreation developments are at Lake Tschida and Sheep Creek Dam. Additional facilities are provided by towns and private groups. Developed facilities are available for such activities as fishing, boating, swimming, softball, camping, picnicking, horseshoes, and rodeos. Public lands are available for hiking, birding, hunting, and crosscountry skiing, which seldom require developed areas. Access to public areas is generally good.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Prepared by Erling B. Podoll, biologist, Soil Conservation Service.

Fish and wildlife resources play an important role in the social and economic life in Grant County. In 1981, about 19 percent of the county residents purchased fishing licenses, compared to slightly more than 17 percent statewide. About 17 percent of the county residents purchased general game and furbearer licenses, compared to about 18 percent statewide.

Wildlife populations currently are lower than they were before the survey area was settled. Habitat quality and diversity are still good, but the extent of the habitat has been reduced because of farming and the resulting loss of rangeland habitat. The county still has a wide variety of game and nongame wildlife. Farming established a habitat for pheasant and gray partridge, which are introduced species.

The most significant game species in the county are the ring-necked pheasant, sharp-tailed grouse, gray partridge, and white-tailed deer. Other important species include ducks, mourning dove, fox squirrel, cottontail rabbit, pronghorn antelope, mule deer, mink, raccoon, badger, striped skunk, red fox, and coyote.

Private landowners manage a total of about 650 acres primarily for wildlife. This acreage is mainly upland habitat. Public areas managed primarily for wildlife include lands surrounding Lake Tschida and the Otter Creek Wildlife Management Area. Both areas are managed by the North Dakota Game and Fish Department.

The major fishing area is Lake Tschida. Other fishing areas include Sheep Creek Reservoir and a number of private reservoirs. Stream fishing is good in certain locations or at certain times of the year in the Heart River, the Cannonball River, and Cedar Creek. The potential for developing new fishing waters or improving existing waters is good. The species of fish sought by anglers are walleye, northern pike, white bass, crappie, catfish, perch, largemouth bass, smallmouth bass, goldeneye, bluegill, and bullhead.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, sunflowers, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall wheatgrass, pubescent wheatgrass, bromegrass, sweetclover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are stiff sunflower, goldenrod, wheatgrass, needlegrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are plum, common chokecherry, buffaloberry, sumac, snowberry, and silver sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include gray partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sharp-tailed grouse, meadowlark, horned lark, and lark bunting.

About 27,500 acres in Grant County, or more than 2.5 percent of the total land area, meets the requirements for hydric soils. The map units in the county that generally display hydric conditions are listed in this section. They are considered hydric soils unless they have been artificially drained or otherwise so altered that they no longer support a predominance of hydrophytic vegetation. The soil maps in this survey do not identify the drained areas. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4, and the location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

33 Arveson fine sandy loam

40 Harriet loam, 1 to 3 percent slopes
41 Heil silty clay
52 Regan clay loam, 0 to 3 percent slopes

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It 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 nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control 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. 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. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, 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 the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the North Dakota State Highway Department Laboratory.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*16*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a frigid moisture temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed Typic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*16*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Amor Series

The Amor series consists of moderately deep, well drained, moderately permeable soils on side slopes in the uplands. These soils formed in loamy material weathered from soft sandstone or siltstone. Slope ranges from 3 to 15 percent.

Typical pedon of Amor loam, 3 to 6 percent slopes, 2,380 feet west and 2,440 feet south of the northeast corner of sec. 32, T. 131 N., R. 88 W.

A—0 to 6 inches; dark brown (10YR 3/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear smooth boundary.

Bw1—6 to 13 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; strong coarse prismatic structure parting to strong medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

Bw2—13 to 20 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; neutral; gradual wavy boundary.

Bw3—20 to 28 inches; light olive brown (2.5Y 5/4) loam, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; mildly alkaline; gradual wavy boundary.

Bk—28 to 37 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common medium irregular soft masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—37 to 60 inches; light yellowish brown (2.5Y 6/4) soft sandstone bedrock that crushes to fine sand; olive brown (2.5Y 4/4) moist; massive; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 10 to 35 inches. The depth to soft bedrock typically is 30 to 40 inches but ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (3 or 4 moist), and chroma of 3 or 4 (2 to 4 moist). It is fine sandy loam, loam, or clay loam. The Bk horizon has hue of 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is loam, fine sandy loam, or clay loam.

Arnegard Series

The Arnegard series consists of deep, well drained, moderately permeable soils on foot slopes in the uplands. These soils formed in loamy alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Arnegard loam, 1 to 3 percent slopes, 750 feet east and 850 feet north of the southwest corner of sec. 13, T. 132 N., R. 85 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; neutral; abrupt smooth boundary.

A—7 to 18 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; soft, very friable, slightly sticky and slightly plastic; common fine roots; neutral; gradual wavy boundary.

Bw1—18 to 27 inches; dark grayish brown (10YR 4/2) 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; few fine roots; neutral; gradual wavy boundary.

Bw2—27 to 39 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; mildly alkaline; gradual wavy boundary.

Bw3—39 to 47 inches; light olive brown (2.5Y 5/4) loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; gradual wavy boundary.

BCk—47 to 60 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine irregular soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 40 inches. The A horizon has hue of 10YR and has value of 2 or 3 when moist. The Bw horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 to 4 moist). It is loam or clay loam. The BCk horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is loam, fine sandy loam, or clay loam.

Arveson Series

The Arveson series consists of deep, poorly drained, moderately rapidly permeable, highly calcareous soils in swales and depressions on uplands. These soils formed in loamy and sandy eolian sediments and alluvium. Slope is 0 to 1 percent.

These soils contain slightly more sand than is definitive for the Arveson series, but this difference does not alter the usefulness or behavior of the soils.

Typical pedon of Arveson fine sandy loam, 1,020 feet north and 210 feet west of the southeast corner of sec. 19, T. 135 N., R. 86 W.

A—0 to 6 inches; very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine and many medium roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

AB—6 to 15 inches; grayish brown (2.5Y 5/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; common fine and many very fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

Bkg—15 to 21 inches; gray (N 6/0) loam, dark gray (N 4/0) moist; massive; hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Ab—21 to 25 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; clear wavy boundary.

C—25 to 60 inches; grayish brown (2.5Y 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; single grain; slightly hard, very friable, nonsticky and nonplastic; slight effervescence; moderately alkaline.

The A horizon has hue of 10YR, value of 3 or 4 (2 moist), and chroma of 1. The Bkg horizon has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 1 or 2 or is dark gray or gray (N 4/0 to N 6/0). It is loam, fine sandy loam, or sandy loam. Some pedons do not have a buried A horizon. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sandy loam, sandy loam, loamy fine sand, loamy sand, or fine sand.

Banks Series

The Banks series consists of deep, somewhat excessively drained, rapidly permeable soils on levees on flood plains. These soils formed in loamy and sandy alluvium. Slope is 0 to 1 percent.

Typical pedon of Banks loam, 2,180 feet east and 1,420 feet south of the northwest corner of sec. 31, T. 132 N., R. 83 W.

A—0 to 4 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; slight effervescence; mildly alkaline; abrupt wavy boundary.

C—4 to 60 inches; grayish brown (2.5Y 5/2) sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; strata of fine sandy loam 0.5 to 0.75 inch thick at depths of 8 and 11 inches; mildly alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. Some pedons have a thin buried A horizon.

Beisigl Series

The Beisigl series consists of moderately deep, somewhat excessively drained, rapidly permeable soils on side slopes in the uplands. These soils formed in sandy material weathered from soft sandstone. Slope ranges from 1 to 15 percent.

Typical pedon of Beisigl loamy fine sand, in an area of Beisigl-Flasher loamy fine sands, 6 to 15 percent slopes, 1,275 feet west and 10 feet south of the northeast corner of sec. 25, T. 131 N., R. 89 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many medium and fine roots; mildly alkaline; clear wavy boundary.

Bw—6 to 12 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, olive brown (2.5Y 4/4) moist; weak fine subangular blocky structure; loose, nonsticky and nonplastic; common medium and fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

BCk—12 to 21 inches; light yellowish brown (2.5Y 6/4) fine sand, light olive brown (2.5Y 5/4) moist; massive; loose, nonsticky and nonplastic; few medium and fine roots; disseminated lime throughout; strong effervescence; moderately alkaline; clear irregular boundary.

Cr—21 to 60 inches; light gray (2.5Y 7/2) soft sandstone bedrock that crushes to fine sand; light yellowish brown (2.5Y 6/4) moist; massive; strong effervescence; moderately alkaline.

The depth to soft sandstone ranges from 20 to 40 inches. The depth to carbonates ranges from 0 to 8 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. The BCk horizon is loamy fine sand, fine sand, or loamy sand. The Cr horizon has hue of 2.5Y or 10YR and chroma of 2 to 4.

Belfield Series

The Belfield series consists of deep, well drained, slowly permeable, alkali soils on foot slopes in the uplands. These soils formed in loamy alluvium or material weathered from soft shale. Slope ranges from 1 to 3 percent.

Typical pedon of Belfield loam, in an area of Grail-Belfield-Daglum complex, 1 to 3 percent slopes, 1,600 feet west and 640 feet south of the northeast corner of sec. 16, T. 133 N., R. 89 W.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear wavy boundary.

A2—5 to 12 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear smooth boundary.

B/E—12 to 16 inches; dark grayish brown (10YR 4/2) clay loam (B), very dark grayish brown (10YR 3/2) moist; light brownish gray (10YR 6/2) silt coatings (E); strong coarse subangular blocky structure parting to weak medium platy; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine pores; neutral; clear wavy boundary.

Bt1—16 to 24 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; few fine roots; common faint clay films on faces of peds; common uncoated sand grains on prism sides; neutral; clear wavy boundary.

Bt2—24 to 39 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; strong coarse prismatic structure parting to strong medium angular blocky; extremely hard, very firm, very sticky and very plastic; few fine roots; common faint clay films on faces of peds; moderately alkaline; gradual wavy boundary.

Bw—39 to 53 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; few small salt crystals; moderately alkaline; gradual wavy boundary.

Bkz—53 to 60 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few small salt crystals; few soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 25 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid or neutral. Some pedons have an E or E/B horizon. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 6 (2 to 5 moist), and chroma of 2 to 4. It is silty clay, silty clay loam, or clay loam. It is neutral to moderately alkaline. The Bkz horizon is silty clay loam, clay loam, loam, or silty clay. It is moderately alkaline or strongly alkaline.

Bowdle Series

The Bowdle series consists of deep, well drained soils on stream terraces. These soils formed in loamy and sandy alluvium. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Bowdle loam, 1 to 3 percent slopes, 1,550 feet north and 1,380 feet east of the southwest corner of sec. 3, T. 129 N., R. 87 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine and few medium roots; neutral; abrupt smooth boundary.

Bw—8 to 23 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; many very fine and few fine roots; neutral; gradual irregular boundary.

2Bk—23 to 28 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; about 10 percent gravel; common fine masses of lime; violent effervescence; mildly alkaline; clear smooth boundary.

2C1—28 to 43 inches; multicolored very gravelly sand; single grain; loose, nonsticky and nonplastic; few very fine roots; about 50 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—43 to 60 inches; grayish brown (10YR 5/2) gravelly sand, dark grayish brown (10YR 4/2) moist; single grain; loose, nonsticky and nonplastic; about 25 percent gravel; mildly alkaline.

The thickness of the mollic epipedon ranges from 16 to 30 inches. The thickness of the solum and the depth to carbonates range from 14 to 32 inches. The depth to sand and gravel is typically 25 to 30 inches, but it ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 1 or 2 (2 moist). The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3 (2 moist). It is loam or clay loam. The 2Bk 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 very gravelly loam, gravelly sandy loam, sandy loam, or loam and is 2 to 5 inches thick.

Brandenburg Series

The Brandenburg series consists of deep, excessively drained soils on hills and ridges in the uplands. These soils formed in loamy material weathered from shattered porcellanite (scoria) bedrock. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 3 to 45 percent.

Typical pedon of Brandenburg channery loam, in an area of Cabba-Brandenburg complex, 3 to 45 percent slopes, 100 feet west and 250 feet south of the northeast corner of sec. 5, T. 136 N., R. 89 W.

A—0 to 4 inches; brown (7.5YR 4/2) channery loam, dark brown (7.5YR 3/2) moist; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; about 20 percent porcellanite channers; mildly alkaline; clear wavy boundary.

C1—4 to 10 inches; reddish brown (5YR 4/4) very channery loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; about 50 percent porcellanite channers; mildly alkaline; clear wavy boundary.

C2—10 to 60 inches; red (2.5YR 5/6) shattered porcellanite bedrock; lime crusts on the undersides of the porcellanite fragments; strong effervescence; moderately alkaline.

The depth to shattered porcellanite ranges from 10 to 20 inches. The A horizon has hue of 7.5YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The content of porcellanite channers in this horizon is about 15 to 35 percent. The C horizon has hue of 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 6.

Breien Series

The Breien series consists of deep, somewhat excessively drained, moderately rapidly permeable soils on flood plains and low terraces. These soils formed in loamy and sandy alluvium. Slope is 0 to 1 percent.

Typical pedon of Breien fine sandy loam, 1,020 feet west and 380 feet south of the northeast corner of sec. 36, T. 132 N., R. 84 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; neutral; abrupt smooth boundary.

A1—6 to 10 inches; dark brown (10YR 3/3) stratified fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; thin layers that are black (10YR 2/1) and very dark grayish brown (10YR 3/2) moist; neutral; clear smooth boundary.

A2—10 to 15 inches; dark grayish brown (10YR 4/2) stratified fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; mildly alkaline; clear irregular boundary.

AC—15 to 22 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; disseminated lime throughout; strong effervescence; moderately alkaline; clear wavy boundary.

C—22 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (2.5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; mildly alkaline.

The depth to sand or loamy fine sand ranges from 14 to 20 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3 (dry or moist). The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3 (dry or moist). It is fine sand, loamy fine sand, loamy sand, or sand. Some pedons have one or more thin layers of very fine sand, loam, or gravel in the C horizon.

Brisbane Series

The Brisbane series consists of deep, well drained soils on broad drainage divides in the uplands. These soils formed in loamy and sandy material weathered from sandstone. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Brisbane loam, 1 to 3 percent slopes, 2,150 feet north and 775 feet east of the southwest corner of sec. 34, T. 131 N., R. 87 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, very friable, sticky and plastic; few very fine roots; medium acid; abrupt smooth boundary.

Bt1—6 to 12 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium blocky; hard, friable, sticky and plastic; few very fine roots; many faint clay films on faces of peds; tongues of the A horizon extending throughout; medium acid; gradual wavy boundary.

Bt2—12 to 17 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium blocky; hard, friable, sticky and plastic; few very fine roots; many distinct clay films on faces of peds; tongues of the A horizon extending throughout; neutral; gradual wavy boundary.

Bk—17 to 31 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; many large irregular soft masses of lime; violent effervescence; mildly alkaline; gradual wavy boundary.

2C—31 to 60 inches; strong brown (7.5YR 5/6) and dark yellowish brown (10YR 4/4) sand, strong brown (7.5YR 4/6) and brown (10YR 4/3) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; thin layer of dark yellowish brown (10YR 4/4) sand, brown (10YR 4/3) moist; mildly alkaline.

The thickness of the solum and the depth to sand typically are 24 to 32 inches but range from 20 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 23 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. It is loam or clay loam.

Cabba Series

The Cabba series consists of shallow, well drained, moderately permeable soils on hills and ridges in the uplands. These soils formed in loamy and silty material weathered from soft siltstone or shale. Slope ranges from 3 to 45 percent.

Typical pedon of Cabba loam, 15 to 45 percent slopes, 280 feet east and 410 feet north of the southwest corner of sec. 11, T. 136 N., R. 90 W.

A—0 to 3 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse and many fine and very fine roots; moderately alkaline; gradual wavy boundary.

AC—3 to 6 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; violent effervescence; strongly alkaline; gradual wavy boundary.

C—6 to 10 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; violent effervescence; strongly alkaline; gradual wavy boundary.

Cr—10 to 60 inches; pale yellow (2.5Y 7/4) siltstone bedrock, light yellowish brown (2.5Y 6/4) moist; few very fine roots in fractures; violent effervescence; moderately alkaline.

The depth to soft bedrock ranges from 8 to 20 inches. The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is loam or silt loam. The C horizon also is loam or silt loam. It has hue of 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The Cr horizon is soft siltstone or shale.

Chama Series

The Chama series consists of moderately deep, well drained, moderately permeable soils on side slopes in the uplands. These soils formed in silty material weathered from soft siltstone. Slope ranges from 6 to 15 percent.

Typical pedon of Chama silt loam, in an area of Chama-Cabba silt loams, 6 to 9 percent slopes, 500 feet west and 340 feet north of the southeast corner of sec. 10, T. 136 N., R. 90 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; moderately alkaline; clear wavy boundary.

Bw—6 to 9 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk—9 to 14 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; disseminated lime throughout; violent effervescence; strongly alkaline; gradual wavy boundary.

C—14 to 34 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; violent effervescence; strongly alkaline; gradual wavy boundary.

Cr—34 to 60 inches; light gray (2.5Y 7/2) soft siltstone bedrock, light brownish gray (2.5Y 6/2) moist; slight effervescence; strongly alkaline.

The depth to soft bedrock is typically 24 to 35 inches but ranges from 20 to 40 inches. The mollic epipedon is 7 to 10 inches thick.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 2. The Bw horizon has hue of 2.5Y or 10YR, value of 4 to 7 (3 to 6 moist), and chroma of 2 or 3. It is silt loam or loam. Some pedons do not have a Bk horizon. This horizon is silt loam or silty clay loam.

Daglum Series

The Daglum series consists of deep, moderately well drained, very slowly permeable, alkali soils on foot slopes in the uplands. These soils formed in silty and loamy alluvium or in material weathered from soft shale. Slope ranges from 1 to 9 percent.

Typical pedon of Daglum loam, 1 to 6 percent slopes, 1,125 feet east and 210 feet north of the southwest corner of sec. 23, T. 131 N., R. 90 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; slightly acid; abrupt smooth boundary.

E—7 to 10 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

Bt1—10 to 15 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure parting to strong coarse blocky; extremely hard, very firm, very sticky and very plastic; few very fine roots; many faint clay films on faces of peds; mildly alkaline; gradual wavy boundary.

Bt2—15 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure parting to strong coarse subangular blocky; extremely hard, very firm, very sticky and very plastic; few very fine roots; many faint clay films on faces of peds; moderately alkaline; gradual wavy boundary.

Bkz—18 to 20 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few fine masses of salts; common medium irregularly shaped soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—20 to 37 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; gradual wavy boundary.

Cy—37 to 48 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; few very fine roots; common nests of gypsum; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—48 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; strong effervescence; strongly alkaline.

The thickness of the mollic epipedon ranges from 7 to 14 inches. The thickness of the solum ranges from 18 to 25 inches. The depth to soft bedrock ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. The E horizon has hue of 10YR, value of 5 to 7 (3 or 4 moist), and chroma of 1 or 2. It is loam or silty clay loam. The Bt horizon has hue of 10YR, value of 4 or 5 (2 to 4 moist), and chroma of 2. It is silty clay or clay. The C horizon has hue of 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4. It is loam, clay loam, silty clay loam, or silty clay.

Daglum Variant

The Daglum Variant consists of shallow, well drained, very slowly permeable, alkali soils on drainage divides in the uplands. These soils formed in silty and loamy material weathered from shale. Slope ranges from 1 to 6 percent.

Typical pedon of Daglum Variant loam, in an area of Daglum Variant-Daglum loams, 1 to 6 percent slopes, 2,540 feet south and 420 feet west of the northeast corner of sec. 16, T. 134 N., R. 90 W.

Ap—0 to 5 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine pores; about 5 percent flagstones; neutral; abrupt smooth boundary.

E—5 to 8 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; neutral; clear wavy boundary.

Bt—8 to 16 inches; dark yellowish brown (10YR 4/4) clay, dark yellowish brown (10YR 3/4) moist; strong medium columnar structure parting to strong medium angular blocky; very hard, very firm, sticky and plastic; few very fine roots; common faint clay films on faces of peds; neutral; gradual wavy boundary.

Btk—16 to 19 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist; moderate medium prismatic structure parting to strong fine subangular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; common faint yellowish brown (10YR 5/4) clay films on faces of peds; disseminated lime throughout; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cr—19 to 60 inches; white (5Y 8/2) weathered shale bedrock; light olive brown (2.5Y 5/4) streaks and fillings.

The depth to shale ranges from 10 to 20 inches. The mollic epipedon is 7 to 10 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR and value of 4 or 5 (3 or 4 moist). It is clay loam, silty clay, or clay.

Desart Series

The Desart series consists of deep, well drained, slowly permeable, alkali soils on terraces and on foot slopes in the uplands. These soils formed in loamy and sandy alluvium or in material weathered from sandstone. Slope ranges from 1 to 6 percent.

Typical pedon of Desart fine sandy loam, 1 to 6 percent slopes, 1,585 feet west and 710 feet north of the southeast corner of sec. 15, T. 133 N., R. 83 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky and weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine pores; slightly acid; gradual wavy boundary.

A2—8 to 17 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

E1—17 to 22 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to weak thick platy; soft, very friable, nonsticky and nonplastic; few fine roots; mildly alkaline; clear wavy boundary.

E2—22 to 25 inches; gray (2.5Y 6/1) very fine sandy loam, dark gray (2.5Y 4/1) moist; weak thick platy structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; moderately alkaline; abrupt wavy boundary.

Bt—25 to 30 inches; light olive gray (5Y 6/2) very fine sandy loam, olive gray (5Y 4/2) moist; strong coarse columnar structure; extremely hard, firm, slightly sticky and nonplastic; few roots between columns; dark grayish brown (2.5Y 4/2 moist) faint clay films on faces of columns; clean sand grains on faces of the columns in the upper 1 inch; strongly alkaline; clear wavy boundary.

Bk—30 to 38 inches; light gray (5Y 7/2) loam, olive gray (5Y 5/2) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; very hard, friable, slightly sticky and slightly plastic; common fine threads and medium soft masses of lime; strong effervescence; strongly alkaline; gradual wavy boundary.

C—38 to 48 inches; light gray (5Y 7/2) loamy fine sand, olive gray (5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; strong effervescence; strongly alkaline; clear smooth boundary.

Cr—48 to 60 inches; light olive gray (5Y 6/2) soft sandstone bedrock, olive gray (5Y 5/2) moist; strong effervescence; strongly alkaline.

The depth to the Bt horizon ranges from 20 to 30 inches. The depth to soft sandstone ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR, value or 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The E horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 1 or 2. The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (3 to 5 moist), and chroma of 2 or 3. It is fine sandy loam, very fine sandy loam, sandy loam, or loam. Some pedons have salt or gypsum crystals in the lower part of the B horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is loam, sandy loam, or loamy fine sand.

Ekalaka Series

The Ekalaka series consists of deep, moderately well drained, slowly permeable, alkali soils on terraces and on foot slopes in the uplands. These soils formed in loamy and sandy alluvium or in material weathered from soft sandstone. Slope ranges from 1 to 9 percent.

Typical pedon of Ekalaka fine sandy loam (fig. 12), in an area of Ekalaka-Lemert fine sandy loams, 1 to 9 percent slopes, 2,110 feet east and 1,300 feet north of the southwest corner of sec. 15, T. 133 N., R. 83 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; few medium and many fine and very fine roots; strongly acid; clear smooth boundary.

E—6 to 12 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak very thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine roots; slightly acid; abrupt smooth boundary.

Bt—12 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure parting to strong medium blocky; extremely hard, firm, nonsticky and slightly plastic; common fine and many very fine roots; clay bridges between sand grains; light gray (10YR 7/2) coatings on faces of peds, dark grayish brown (10YR 4/2) moist; neutral; gradual wavy boundary.

Bz1—17 to 21 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, friable, nonsticky and slightly plastic; common very fine roots; many masses and filaments of salts;

Figure 12.—Columnar structure characteristic of the Bt horizon in Ekalaka soils.

slight effervescence; mildly alkaline; gradual wavy boundary.

Bz2—21 to 25 inches; pale brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; very hard, friable, nonsticky and nonplastic; few very fine roots; few threads of salts; slight effervescence; mildly alkaline; clear wavy boundary.

Cz—25 to 33 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; many large prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; massive; very hard, firm, nonsticky and nonplastic; few very fine roots; few threads of salts; slight effervescence; mildly alkaline; gradual wavy boundary.

C—33 to 60 inches; light gray (5Y 7/2) fine sandy loam, olive gray (5Y 4/2) moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; moderately alkaline.

The thickness of the solum ranges from 18 to 35 inches. The depth to the Bt horizon ranges from 9 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. The E horizon has hue of 10YR, value of 5 or 6 (3 or 4 moist), and chroma of 2. It is fine sandy loam or loamy fine sand. The Bt horizon has hue of 10YR, value of 4 or 5 (3 to 5 moist), and chroma of 2 to 4. It is fine sandy loam or sandy loam. The C horizon has hue of 5Y or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2. It is loamy fine sand, loamy sand, fine sandy loam, or fine sand.

Flasher Series

The Flasher series consists of shallow, somewhat excessively drained, moderately rapidly permeable soils on hills and ridges in the uplands. These soils formed in sandy material weathered from sandstone. Slope ranges from 3 to 45 percent.

Typical pedon of Flasher loamy fine sand, 15 to 45 percent slopes, 1,110 feet north and 195 feet west of the southeast corner of sec. 3, T. 134 N., R. 86 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; many roots; stained quartz sand grains; slight effervescence; mildly alkaline; gradual wavy boundary.

C—6 to 10 inches; light olive brown (2.5Y 5/4) loamy fine sand, olive brown (2.5Y 4/4) moist; weak fine subangular blocky structure; loose, nonsticky and nonplastic; few small hard sandstone fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

Cr—10 to 60 inches; light yellowish brown (2.5Y 6/4) soft sandstone bedrock that crushes to sand; olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) moist; slight effervescence; moderately alkaline.

The depth to soft sandstone typically is 8 to 15 inches but ranges from 7 to 20 inches. The A horizon has hue of 10YR, 2.5Y, or 7.5YR, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. The C horizon has hue of 5Y, 2.5Y, or 10YR, value of 4 to 8 (3 to 6 moist), and chroma of 2 to 4. It is loamy fine sand, fine sand, or loamy sand. In some pedons, lime is diffused throughout the soil and has accumulated in the form of threads or soft masses. Some pedons have layers of hard sandstone in the Cr horizon.

Grail Series

The Grail series consists of deep, well drained, moderately slowly permeable soils on foot slopes in the uplands. These soils formed in silty and loamy alluvium. Slope ranges from 1 to 3 percent.

Typical pedon of Grail silty clay loam, 1 to 3 percent slopes, 2,000 feet south and 1,100 feet east of the northwest corner of sec. 23, T. 131 N., R. 90 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; slightly acid; abrupt smooth boundary.

Bt1—8 to 17 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; few faint clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—17 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; few faint clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bk—24 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; disseminated lime throughout; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—36 to 47 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—47 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 40 inches. The A horizon has hue of 10YR and chroma of 1 or 2. It has value of 2 or 3 when moist. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. The C horizon has hue of 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2. It is loam, silt loam, silty clay loam, clay loam, silty clay, or clay.

Harriet Series

The Harriet series consists of deep, poorly drained, very slowly permeable, alkali, moderately saline soils on terraces and flood plains. These soils formed in loamy alluvium. Slope ranges from 1 to 3 percent.

Typical pedon of Harriet loam, 1 to 3 percent slopes, 2,230 feet west and 2,190 feet north of the southeast corner of sec. 23, T. 132 N., R. 84 W.

E—0 to 2 inches; gray (10YR 5/1) and light gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; neutral; abrupt wavy boundary.

Bt—2 to 4 inches; dark grayish brown (10YR 4/2) clay loam, very dark gray (10YR 3/1) moist; strong coarse columnar structure; hard, firm, slightly sticky and slightly plastic; common fine and medium roots; few faint clay films on faces of peds; strongly alkaline; clear wavy boundary.

Btz—4 to 10 inches; dark grayish brown (10YR 4/2) clay loam, very dark gray (10YR 3/1) moist; moderate coarse prismatic structure; slightly hard, friable, sticky and plastic; few fine roots; few faint clay films on faces of peds; few small salt crystals; slight effervescence; strongly alkaline; gradual wavy boundary.

C1—10 to 27 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; strongly alkaline; gradual wavy boundary.

C2—27 to 37 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; slight effervescence; very strongly alkaline; gradual wavy boundary.

C3—37 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; many large soft masses of lime; violent effervescence; very strongly alkaline.

Some pedons have an A horizon, which is 1 to 2 inches thick. The E horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is clay loam or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1 to 3. It is loam, clay loam, or silty clay loam.

Heil Series

The Heil series consists of deep, poorly drained, very slowly permeable, alkali soils in depressions on uplands. These soils formed in clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Heil silty clay, 2,180 feet west and 110 feet north of the southeast corner of sec. 33, T. 133 N., R. 83 W.

E—0 to 2 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; common fine distinct yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; many fine and medium roots; slightly acid; abrupt wavy boundary.

Bt1—2 to 8 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong coarse columnar structure parting to strong medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few faint clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—8 to 17 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to strong medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few faint clay films on faces of peds; moderately alkaline; gradual wavy boundary.

Bw—17 to 26 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few fine soft masses of lime; slight effervescence; mildly alkaline; gradual wavy boundary.

Cg1—26 to 34 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; weak medium subangular blocky structure; extremely hard, very firm, sticky and plastic; large white soft masses of lime and salts; strong effervescence; strongly alkaline; gradual wavy boundary.

Cg2—34 to 60 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; massive; extremely hard, very firm, sticky and plastic; few fine soft masses of lime; slight effervescence; mildly alkaline.

The depth to carbonates ranges from 15 to 35 inches. Some pedons have an A horizon, which is 1 to 3 inches thick. The E horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 1. The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is silty clay or clay. The Cg horizon has hue of 5Y, value of 5 or 6 (3 or 4 moist), and chroma of 1. It is silty clay loam, silty clay, or clay.

Lawther Series

The Lawther series consists of deep, well drained, slowly permeable soils on terraces and on foot slopes in the uplands. These soils formed in clayey alluvium. Slope ranges from 1 to 3 percent.

Typical pedon of Lawther silty clay, 1 to 3 percent slopes, 2,080 feet west and 1,150 feet south of the northeast corner of sec. 18, T. 130 N., R. 88 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate fine granular structure; very hard, friable, sticky and plastic; few fine roots; mildly alkaline; abrupt smooth boundary.

Bw—5 to 22 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak coarse prismatic structure parting to moderate fine angular blocky; very hard, friable, sticky and very plastic; mildly alkaline; gradual wavy boundary.

Bk—22 to 33 inches; dark gray (5Y 4/1) clay, black (5Y 2/1) moist; weak coarse prismatic structure parting to moderate fine angular blocky; very hard, firm, sticky and very plastic; disseminated lime throughout; slight effervescence; moderately alkaline; gradual wavy boundary.

Cy—33 to 60 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; weak medium subangular blocky structure; very hard, firm, sticky and very plastic; few medium masses of gypsum; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to more than 30 inches. The thickness of the solum ranges from 25 to 45 inches. When the soils are dry, cracks 0.5 inch to 2.0 inches wide and several feet long extend downward into the solum.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The B and Cy horizons are clay or silty clay. The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The Cy horizon has hue of 2.5Y or 5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 to 3.

Lemert Series

The Lemert series consists of deep, moderately well drained, slowly permeable, alkali soils on terraces and on foot slopes in the uplands. These soils formed in sandy and loamy alluvium or in material weathered from sandstone. Slope ranges from 1 to 3 percent.

Typical pedon of Lemert fine sandy loam, in an area of Ekalaka-Lemert fine sandy loams, 1 to 9 percent slopes, 2,100 feet east and 1,300 feet north of the southwest corner of sec. 15, T. 133 N., R. 83 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; few medium and many fine and very fine roots; strongly acid; clear smooth boundary.

E—2 to 5 inches; light brownish gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; strongly acid; abrupt smooth boundary.

Bt—5 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure parting to strong medium blocky; extremely hard, extremely firm, slightly sticky and plastic; common fine and many very fine roots; clay bridges between sand grains; light gray (10YR 7/2) coatings on peds, dark grayish brown (10YR 4/2) moist; neutral; gradual wavy boundary.

Bkz—10 to 16 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium blocky; hard, friable, nonsticky and nonplastic; common fine and very fine roots; common large irregular segregated concretions of salts; many medium rounded soft masses and filaments or threads of lime; strong effervescence; mildly alkaline; gradual wavy boundary.

Bz—16 to 24 inches; pale brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, very friable, nonsticky and nonplastic; few very fine roots; few fine masses of salts; strong effervescence; moderately alkaline; clear smooth boundary.

C1—24 to 36 inches; pale brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; massive; extremely hard, friable, nonsticky and nonplastic; few very fine roots; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—36 to 60 inches; light gray (5Y 7/2) fine sandy loam, olive gray (5Y 4/2) moist; massive; hard, friable, nonsticky and nonplastic; few very fine roots; moderately alkaline.

The thickness of the solum ranges from 18 to 35 inches. The depth to the Bt horizon ranges from 4 to 20 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. The E horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2. It is loamy fine sand, sandy loam, or fine sandy loam. The Bt horizon has hue of 10YR, value of 3 to 6 (2 or 3 moist), and chroma of 2 or 3. It is loamy fine sand or fine sandy loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 6 or 7 (3 or 4 moist), and chroma of 2 or 3. It is loamy fine sand, loamy sand, or fine sandy loam.

Lihen Series

The Lihen series consists of deep, well drained, rapidly permeable soils on side slopes and in swales on uplands. These soils formed in sandy alluvium or eolian sediments. Slope ranges from 1 to 6 percent.

Typical pedon of Lihen loamy fine sand, 1 to 6 percent slopes, 1,100 feet west and 200 feet south of the northeast corner of sec. 11, T. 133 N., R. 83 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; neutral; abrupt smooth boundary.

A—8 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to single grain; loose, nonsticky and nonplastic; many fine roots; neutral; gradual wavy boundary.
AC—14 to 27 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; loose, nonsticky and nonplastic; common fine roots; neutral; gradual wavy boundary.
C—27 to 60 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; neutral.

The thickness of the mollic epipedon ranges from 20 to more than 30 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2. It is loamy sand, loamy fine sand, or sandy loam.

Moreau Series

The Moreau series consists of moderately deep, well drained, slowly permeable soils on side slopes and knolls in the uplands. These soils formed in silty and clayey material weathered from soft shale. Slope ranges from 3 to 9 percent.

These soils have a slightly lighter colored surface layer than is definitive for the Moreau series, but this difference does not alter the usefulness or behavior of the soils.

Typical pedon of Moreau clay loam, 3 to 6 percent slopes, 1,500 feet west and 2,500 feet south of the northeast corner of sec. 6, T. 137 N., R. 90 W.

Ap—0 to 5 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; extremely hard, firm, sticky and plastic; common fine roots; slight effervescence; strongly alkaline; abrupt smooth boundary.
Bw1—5 to 8 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; strong effervescence; strongly alkaline; gradual wavy boundary.
Bw2—8 to 12 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; strong effervescence; strongly alkaline; gradual wavy boundary.
Cy—12 to 21 inches; light yellowish brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) moist; massive; extremely hard, very firm, sticky and plastic; few fine roots; many gypsum crystals; slight effervescence; strongly alkaline; gradual wavy boundary.
Cr—21 to 60 inches; light brownish gray (2.5Y 6/2) soft shale bedrock; slight effervescence; strongly alkaline.

The depth to soft shale ranges from 20 to 40 inches. The A horizon has hue of 2.5Y or 10YR and value of 4 or 5 (2 to 4 moist). The B horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay, clay, or silty clay 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 clay, silty clay, or silty clay loam. Lime is diffused or occurs as soft masses.

Parshall Series

The Parshall series consists of deep, well drained, moderately rapidly permeable soils on terraces and on foot slopes in the uplands. These soils formed in loamy alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Parshall fine sandy loam, 1 to 6 percent slopes, 1,600 feet south and 680 feet west of the northeast corner of sec. 18, T. 133 N., R. 90 W.

Ap—0 to 9 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; common fine roots; neutral; abrupt smooth boundary.
Bw—9 to 25 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 weak fine granular; soft, very friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.
Bk—25 to 33 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few fine roots; disseminated lime throughout; slight effervescence; mildly alkaline; gradual wavy boundary.
C1—33 to 41 inches; light brownish gray (2.5Y 6/2) sandy loam, grayish brown (2.5Y 5/2) moist; weak fine granular structure; few pebbles; soft, very friable, slightly sticky and slightly plastic; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.
C2—41 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; weak fine subangular blocky structure parting to weak fine granular; very friable; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 30 inches. The depth to carbonates ranges from 24 to more than 60 inches.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 2. The Bw horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is fine sandy loam or sandy loam. The C horizon has hue of 2.5Y or 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. It is fine sandy loam, sandy loam, or loamy fine sand.

Regan Series

The Regan series consists of deep, poorly drained, moderately slowly permeable, highly calcareous, slightly saline soils on flood plains and in swales on uplands. These soils formed in loamy alluvium. Slope ranges from 0 to 3 percent.

These soils contain slightly more sand than is definitive for the Regan series, but this difference does not alter the usefulness or behavior of the soils.

Typical pedon of Regan clay loam, 0 to 3 percent slopes, 150 feet east and 2,000 feet south of the northwest corner of sec. 29, T. 134 N., R. 86 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; strong effervescence; mildly alkaline; clear wavy boundary.

A2—5 to 11 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many fine roots; strong effervescence; mildly alkaline; gradual wavy boundary.

Bk—11 to 20 inches; light gray (10YR 6/1) and dark gray (10YR 4/1) clay loam, gray (10YR 5/1) and very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few fine roots; disseminated lime throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

Ab—20 to 25 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; strong effervescence; mildly alkaline; gradual wavy boundary.

C1—25 to 36 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to weak fine granular; very hard, friable, sticky and plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—36 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, sticky and plastic; common fine irregularly shaped soft masses of lime; strong effervescence; mildly alkaline.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1 or 2. It is loam, clay loam, or silty clay loam.

Regent Series

The Regent series consists of moderately deep, well drained, slowly permeable soils on side slopes in the uplands. These soils formed in silty material weathered from soft shale or siltstone. Slope ranges from 3 to 9 percent.

Typical pedon of Regent silty clay loam, 3 to 6 percent slopes, 1,925 feet east and 1,900 feet south of the northwest corner of sec. 21, T. 131 N., R. 88 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; mildly alkaline; abrupt smooth boundary.

Bt1—6 to 14 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; slightly hard, friable, very sticky and very plastic; common very fine and fine roots; few thin clay films on faces of peds; mildly alkaline; clear irregular boundary.

Bt2—14 to 18 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; slightly hard, friable, very sticky and very plastic; common very fine and fine roots; few faint clay films on faces of peds; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk1—18 to 25 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; common fine and very fine roots; many fine rounded soft masses of lime; violent effervescence; moderately alkaline; gradual irregular boundary.

Bk2—25 to 35 inches; light olive gray (5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; common very fine and fine roots; many fine rounded soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—35 to 60 inches; light olive gray (5Y 6/2) soft shale bedrock, olive gray (5Y 4/2) moist; few fine and common very fine roots; common fine rounded soft masses of lime; strong effervescence; moderately alkaline.

The depth to soft shale or siltstone ranges from 20 to 40 inches. The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. The Bk horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is clay loam, silty clay loam, silty clay, or clay. The Cr horizon is siltstone or shale.

Rhoades Series

The Rhoades series consists of deep, moderately well drained, very slowly permeable, alkali soils on terraces and on side slopes and foot slopes in the uplands. These soils formed in clayey alluvium or in material weathered from soft shale. Slope ranges from 1 to 9 percent.

Typical pedon of Rhoades loam, in an area of Rhoades-Daglum loams, 1 to 9 percent slopes, 750 feet north and 1,660 feet east of the southwest corner of sec. 23, T. 131 N., R. 90 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt smooth boundary.

E—3 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; neutral; clear irregular boundary.

Bt—5 to 12 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse columnar structure parting to strong coarse angular blocky; extremely hard, firm, very sticky and very plastic; common very fine roots; many faint clay films on faces of peds; moderately alkaline; gradual wavy boundary.

Btz—12 to 16 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong coarse subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; many faint clay films on faces of peds; few salt crystals; moderately alkaline; clear wavy boundary.

Byz—16 to 33 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; nests of salt and gypsum crystals; strong effervescence; moderately alkaline; gradual irregular boundary.

C1—33 to 48 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, very sticky and very plastic; many large irregular soft masses of lime; strong effervescence; strongly alkaline; gradual wavy boundary.

C2—48 to 60 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, firm, very sticky and very plastic; many large irregular soft masses of lime; slight effervescence; moderately alkaline.

The depth to soft shale ranges from 38 to more than 60 inches. The A and E horizons have a combined thickness of 1 to 5 inches. The E horizon has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2. It is loam, silt loam, or fine sandy loam. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 2. It is silty clay or clay. The C horizon has hue of 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2. It is loam, silty clay loam, silty clay, or clay.

Ruso Series

The Ruso series consists of deep, well drained soils on terraces. These soils formed in loamy and sandy alluvium. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 6 percent.

Typical pedon of Ruso fine sandy loam, 1 to 6 percent slopes, 1,800 feet north and 144 feet east of the southwest corner of sec. 9, T. 131 N., R. 84 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bw1—5 to 14 inches; brown (10YR 4/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; gradual wavy boundary.

Bw2—14 to 24 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; gradual wavy boundary.

BC—24 to 29 inches; brown (10YR 4/3) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; mildly alkaline; clear wavy boundary.

2C1—29 to 36 inches; brown (10YR 4/3) gravelly loamy coarse sand, dark brown (10YR 3/3) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; about 15 percent gravel; mildly alkaline; gradual wavy boundary.

2C2—36 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; slight effervescence; mildly alkaline.

The depth to sand and gravel ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 2. It is fine sandy loam or sandy loam. In some pedons carbonates are at a depth of about 20 inches.

Savage Series

The Savage series consists of deep, well drained, slowly permeable soils on alluvial fans and foot slopes in the uplands. These soils formed in silty alluvium. Slope ranges from 2 to 6 percent.

Typical pedon of Savage clay loam, 2 to 6 percent slopes, 2,190 feet south and 2,100 feet east of the northwest corner of sec. 33, T. 131 N., R. 89 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; slightly acid; abrupt smooth boundary.

Bt1—6 to 11 inches; dark brown (10YR 4/3) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky and very plastic; many faint clay films on faces of peds; neutral; clear wavy boundary.

Bt2—11 to 17 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, very firm, very sticky and very plastic; few faint clay films on faces of peds; neutral; gradual wavy boundary.

Bw—17 to 26 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; slight effervescence; mildly alkaline; gradual wavy boundary.

Bk1—26 to 35 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many fine soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—35 to 47 inches; light brownish gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; many fine soft masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—47 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few fine soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 9 to 16 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The Bt 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 silty clay, clay, or silty clay loam. The C horizon has hue of 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is silty clay loam, clay loam, silt loam, or loam. Some pedons have pebbles or porcellanite (scoria) fragments in the C horizon.

Schaller Series

The Schaller series consists of deep, excessively drained, very rapidly permeable soils on outwash terraces. These soils formed in loamy and sandy outwash. Slope ranges from 3 to 45 percent.

Typical pedon of Schaller fine sandy loam, in an area of Schaller-Cabba complex, 3 to 45 percent slopes, 700 feet east and 90 feet south of the northwest corner of sec. 18, T. 131 N., R. 84 W.

A—0 to 9 inches; dark brown (10YR 3/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bk—9 to 15 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; about 5 percent gravel; lime disseminated throughout and occurring as many fine soft masses; strong effervescence; mildly alkaline; abrupt wavy boundary.

C—15 to 60 inches; light yellowish brown (2.5Y 6/4) gravelly loamy coarse sand, light olive brown (2.5Y 5/4) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; about 20 percent gravel; mildly alkaline.

The depth to carbonates ranges from 5 to 15 inches. In some pedons the carbonates occur only as coatings on the underside of pebbles. The thickness of the mollic epipedon generally is 7 to 9 inches but ranges to 14 inches.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 2 or 3 (dry or moist). The Bk horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is coarse sand, gravelly sand, loamy fine sand, fine sandy loam, or gravelly coarse sand. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is coarse sand, loamy coarse sand, sand, gravelly sand, or gravelly coarse sand. The sand is dominantly medium and coarse. The content of gravel in this horizon is about 5 to 35 percent.

Sen Series

The Sen series consists of moderately deep, well drained, moderately permeable soils on side slopes in the uplands. These soils formed in silty material weathered from soft siltstone. Slope ranges from 3 to 6 percent.

Typical pedon of Sen silt loam, 3 to 6 percent slopes, 75 feet south and 320 feet west of the northeast corner of sec. 8, T. 137 N., R. 88 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bw1—6 to 10 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.

Bw2—10 to 16 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and slightly plastic; mildly alkaline; clear wavy boundary.

Bk1—16 to 19 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and slightly plastic; lime disseminated throughout and occurring as few soft masses; strong effervescence; strongly alkaline; clear wavy boundary.

Bk2—19 to 26 inches; light gray (2.5Y 7/2) silt loam, light yellowish brown (2.5Y 6/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and slightly plastic; lime disseminated throughout and occurring as few fine soft masses; violent effervescence; strongly alkaline; clear wavy boundary.

C—26 to 33 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/6) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; strongly alkaline; clear wavy boundary.

Cr—33 to 60 inches; light olive brown (2.5Y 5/4) stratified soft siltstone bedrock; slight effervescence.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The depth to soft siltstone is typically 30 to 40 inches but ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bw 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 silt loam or loam. The C horizon has hue of 2.5Y, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 6. It is silt loam or silty clay loam.

Seroco Series

The Seroco series consists of deep, excessively drained, rapidly permeable soils on ridges and knobs in the uplands. These soils formed in sandy alluvium or eolian sediments. Slope ranges from 1 to 15 percent.

Typical pedon of Seroco loamy fine sand, in an area of Telfer-Seroco loamy fine sands, 1 to 9 percent slopes, 2,130 feet south and 150 feet west of the northeast corner of sec. 25, T. 135 N., R. 87 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to single grain; soft, very friable, nonsticky and nonplastic; common fine roots; neutral; abrupt smooth boundary.

C1—7 to 34 inches; brown (10YR 5/3) loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

C2—34 to 60 inches; light olive brown (2.5Y 5/4) loamy fine sand, olive brown (2.5Y 4/4) moist; single grain; loose, nonsticky and nonplastic; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 30 to more than 60 inches. The A horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. 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.

Shambo Series

The Shambo series consists of deep, well drained, moderately permeable soils on terraces and on alluvial fans in the uplands. These soils formed in loamy alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Shambo loam, 3 to 6 percent slopes, 1,150 feet east and 1,800 feet south of the northwest corner of sec. 27, T. 131 N., R. 90 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt smooth boundary.

A—9 to 13 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

Bw1—13 to 20 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; mildly alkaline; gradual wavy boundary.

Bw2—20 to 29 inches; light olive brown (2.5Y 5/4) loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; mildly alkaline; clear wavy boundary.

Bk—29 to 42 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; disseminated lime throughout; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—42 to 48 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; strongly alkaline; gradual smooth boundary.

C2—48 to 60 inches; light gray (2.5Y 7/2) loam, light yellowish brown (2.5Y 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; strongly alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. It is loam or clay loam. The C horizon has hue of 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam, fine sandy loam, silt loam, silty clay loam, or clay loam. In some pedons gravel is at a depth of 40 to 60 inches.

Straw Series

The Straw series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Straw loam, 0 to 3 percent slopes, 1,800 feet south and 1,650 feet west of the northeast corner of sec. 7, T. 131 N., R. 87 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; abrupt smooth boundary.

A1—8 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; slight effervescence; neutral; clear wavy boundary.

A2—15 to 27 inches; grayish brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and common medium roots; many medium irregular soft masses of lime; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—27 to 34 inches; light yellowish brown (2.5Y 6/4) and pale yellow (2.5Y 7/4) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; many very fine and fine and few medium roots; common fine filaments or threads of lime; strong effervescence; mildly alkaline; clear wavy boundary.

Ab—34 to 43 inches; gray (10YR 5/1) and dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; common fine filaments or threads of lime; strong effervescence; mildly alkaline; clear wavy boundary.

C2—43 to 60 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine roots; common fine rounded soft masses of lime; strong effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 16 to 35 inches. The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. Some pedons are calcareous in the upper 8 inches. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 or 4 moist), and chroma of 2 to 4.

Telfer Series

The Telfer series consists of deep, excessively drained, rapidly permeable soils on side slopes in the uplands. These soils formed in sandy eolian sediments. Slope ranges from 1 to 9 percent.

Typical pedon of Telfer loamy fine sand, in an area of Telfer-Seroco loamy fine sands, 1 to 9 percent slopes, 2,280 feet west and 1,450 feet north of the southeast corner of sec. 20, T. 135 N., R. 86 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; neutral; clear wavy boundary.

AC—5 to 11 inches; brown (10YR 4/3) loamy sand, dark brown (10YR 3/3) moist; single grain; loose, nonsticky and nonplastic; common fine and very fine roots; neutral; clear wavy boundary.

C1—11 to 16 inches; olive brown (2.5Y 4/4) loamy sand, very dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; neutral; gradual wavy boundary.

C2—16 to 60 inches; light olive brown (2.5Y 5/4) fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; neutral.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The AC horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loamy fine sand, loamy sand, or 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.

Vebar Series

The Vebar series consists of moderately deep, well drained, moderately rapidly permeable soils on side slopes in the uplands. These soils formed in loamy material weathered from sandstone. Slope ranges from 1 to 15 percent.

Typical pedon of Vebar fine sandy loam, in an area of Vebar-Parshall fine sandy loams, 1 to 6 percent slopes, 130 feet east and 200 feet south of the northwest corner of sec. 23, T. 133 N., R. 89 W.

Ap—0 to 6 inches; dark brown (10YR 4/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt smooth boundary.

Bw1—6 to 13 inches; brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; few fine roots; slightly acid; gradual wavy boundary.

Bw2—13 to 24 inches; light olive brown (2.5Y 5/4) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; few fine roots; neutral; gradual wavy boundary.

C—24 to 31 inches; light olive brown (2.5Y 5/4) sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few sandstone fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cr—31 to 60 inches; light yellowish brown (2.5Y 6/4) calcareous sandstone bedrock; strong effervescence; moderately alkaline.

The depth to sandstone ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. It is fine sandy loam or sandy loam. Some pedons have a Bk horizon. The C horizon has hue of 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is sandy loam, fine sandy loam, or loamy fine sand.

Velva Series

The Velva series consists of deep, well drained, moderately rapidly permeable soils on terraces and flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Velva fine sandy loam, 0 to 3 percent slopes, 980 feet south and 1,720 feet east of the northwest corner of sec. 36, T. 132 N., R. 87 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; neutral; abrupt smooth boundary.

C1—6 to 12 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots; lime masses in the lower part; neutral; gradual wavy boundary.

C2—12 to 30 inches; grayish brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, friable, slightly sticky and slightly plastic; common very fine roots; common fine soft masses of lime; strong effervescence; neutral; clear wavy boundary.

C3—30 to 38 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few lignite fragments; few fine rounded soft masses of lime; slight effervescence; mildly alkaline; clear wavy boundary.

C4—38 to 44 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; slight effervescence; mildly alkaline; clear wavy boundary.

C5—44 to 60 inches; grayish brown (2.5Y 5/2) stratified loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 9 to 16 inches. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. Some pedons have a buried A horizon, and some have a B horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is fine sandy loam, sandy loam, or loam. In some pedons it has thin layers of finer or coarser textured material.

Formation of the Soils

Soils form 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 during 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, mainly 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 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.

Parent Material

Properties of the parent material help to determine the kinds of soil that form in the material. Texture is one of the most important physical properties of the parent material because it determines the texture of most soils. Other properties can also be important. For example, soils containing excess sodium salts generally formed in parent material that also contained excess sodium salts.

The parent material of the soils in Grant County has several different origins. The most extensive parent material is that weathered from soft residual bedrock of the Tertiary Period and a small area of residual bedrock of the Cretaceous Period. The exposed bedrock in Grant County is referred to as continental sediment, meaning that the sediment was deposited by running water of streams and rivers and by the wind. The deeper sediment, such as that which provides the source of water for artesian wells, is marine sediment originally deposited in shallow salt-water seas. The Fort Union Formation of the Tertiary Period and the Hell Creek Formation of the Cretaceous Period are exposed in Grant County.

The Fort Union Formation has five members that make up the major part of the surficial geology in the county. These are Sentinel Butte Formation, in the extreme northwest part of the county; Bullion Creek Formation, in the northwestern and west-central parts; and the Cannonball, Ludlow, and Slope Formations, in the central part. These five formations were laid down during the Paleocene Epoch. They consist of silt, clay, sand, lignite, petrified wood, and scoria (porcellanite) and deposits that include soft bedrock, shale, sandstone, and extremely hard rock. The parent material of Amor, Regent, Cabba, Vebar, and Flasher soils is of the Fort Union Formation.

The Hell Creek Formation crops out in the southeastern part of the county, along the Cannonball River and Cedar Creek. It was deposited near the end of the Cretaceous Period and is the oldest surficial formation in the county. This formation consists of several different types of rock. It is mainly gray sand with numerous strata of brown to black lignitic shale. The sand and shale, though hard when dry, are easily eroded by heavy rains. Unless protected by vegetation, the Hell Creek Formation forms rugged buttes with steep sides, which are severely gullied by erosion. Badland and the Cabba soils formed in parent material of the Hell Creek Formation.

Glacial material is another type of continental sediment. It was deposited by glacial ice or glacial meltwater. Glaciers covered most of the northern and eastern parts of the county. In only a few areas, however, the glacial deposits that remain are thick enough for soil formation. Erosion has removed much of the fill material and has left the glacial boulders as the only evidence of glaciation. Shambo, Bowdle, and Ruso are examples of soils that formed in material deposited by glacial meltwater.

The parent material of the soils on flood plains and terraces is alluvium deposited by the floodwater of streams. These soils are stratified and subject to flooding. Some have an old, buried surface layer. Banks, Straw, and Velva soils, which are along the Heart and Cannonball Rivers and along some of the larger creeks, are examples of soils that formed in alluvium.

In a few areas the soils formed in material weathered from porcellanite, or scoria, in the lignite coal veins in the Fort Union Formation. Porcellanite, a natural reddish brick, formed when the heat from the burning lignite coal baked the adjacent sediment. Brandenburg soils formed in material weathered from porcellanite.

Savage, Grail, and Lawther soils formed in local alluvial sediment on residual uplands. The formation of the Harriet, Rhoades, and Daglum soils was affected by salts, particularly sodium, in the parent material.

Climate

Climate is perhaps the most influential factor of soil formation. It affects the physical and chemical processes of weathering and the biological activities in the soil. The processes of soil formation are most active if the climate is warm and moist. Climate influences these processes to a large extent through its effect on vegetation. Grant 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 soil particles in 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, climate prevents large yields of vegetation, but it allows a slow rate of plant decay, which enables organic matter to accumulate in the soil.

Plant and Animal Life

Plants have significantly influenced the formation of soils in Grant County. Earthworms, small animals, and micro-organisms are also important but to a lesser extent.

The native vegetation was mostly of mid and short grasses. Plant roots act as physical and chemical agents in weathering the parent material. Animal life and micro-organisms break the dead plant tissues into humus, thus releasing plant nutrients. The plant roots provide a medium whereby nutrients that have been leached into the lower part of the soil are brought back to the surface.

Relief

Relief, or the lay of the land, influences soil formation mainly through its effect on 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. Heil soils, which are in depressions, exhibit an advanced degree of horizonation because of the alternate wetting and drying cycle that occurs in the depressions. In contrast, the steeply sloping Cabba soils exhibit a minimal degree of horizonation. Shambo, Grail, and other soils having gentle slopes generally support a more luxuriant plant cover than the steeper soils and have a more strongly expressed profile. The steeper Flasher and Brandenburg soils generally have sparse vegetation, have lime close to the surface, and are low in content of organic matter. They have a minimally developed profile.

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 Brisbane soils on residual uplands than for the formation of Banks soils on flood plains along the Cannonball River. The forces of soil formation have been continually acting on the parent material of the Brisbane soils; however, Banks soils are frequently flooded and receive new material during each flood. Brisbane soils have well defined horizons and a high content of organic matter, and Banks soils do not have distinct horizons and have a low content of organic matter.

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Glossary

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 (in tables). 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	9 to 12
Very high	more than 12

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.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

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 flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

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 channer.

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 coating, 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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

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 they are wet 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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most 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 (in tables). The rapid movement of water into the soil.

Fine textured soil. Sandy clay, silty clay, and clay.

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.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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).

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Riverwash. An alluvial deposit in a riverbed or on a flood plain subject to erosion and deposition during recurring periods of flooding.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

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, the slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption 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

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

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 layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 9 inches (10 to 23 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. An A horizon 10 inches or more thick.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at Carson, North Dakota]

Month	Temperature						Precipitation				
	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*	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----	18.6	-2.9	7.9	50	-33	0	0.33	0.12	0.49	2	5.2
February---	26.4	4.8	15.6	54	-26	17	.40	.11	.63	2	4.7
March------	35.9	14.1	25.0	71	-19	40	.60	.11	.98	2	5.2
April------	53.1	29.0	41.1	85	6	153	1.85	.64	2.86	5	3.2
May--------	66.9	40.8	53.9	91	21	438	2.68	1.44	3.76	7	.6
June-------	75.1	50.8	63.0	96	34	690	3.62	2.22	4.88	8	.0
July-------	83.2	56.1	69.7	102	40	921	2.39	1.16	3.44	6	.0
August-----	82.6	53.8	68.2	102	37	874	1.89	.67	2.91	5	.0
September--	70.7	42.9	56.8	97	22	504	1.38	.40	2.17	4	.0
October----	58.9	31.6	45.3	87	13	216	.84	.13	1.39	2	1.4
November---	39.5	16.9	28.2	70	-12	25	.43	.01	.73	2	3.2
December---	26.6	5.6	16.1	57	-29	20	.36	.08	.57	1	5.2
Yearly:											
Average--	53.1	28.9	40.9	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-33	---	---	---	---	---	---
Total----	---	---	---	---	---	3,898	16.77	13.27	20.08	46	28.7

* 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 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at Carson, North Dakota]

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 16	May 22	June 6
2 years in 10 later than--	May 10	May 17	May 31
5 years in 10 later than--	Apr. 28	May 7	May 20
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 21	Sept. 11	Aug. 31
2 years in 10 earlier than--	Sept. 27	Sept. 17	Sept. 6
5 years in 10 earlier than--	Oct. 9	Sept. 27	Sept. 17

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at Carson, North Dakota]

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	139	120	96
8 years in 10	147	128	104
5 years in 10	164	142	119
2 years in 10	180	156	133
1 year in 10	188	164	141

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1B	Amor loam, 3 to 6 percent slopes	83,190	7.7
1C	Amor loam, 6 to 9 percent slopes	51,430	4.8
3D	Amor-Cabba loams, 3 to 15 percent slopes, very stony	13,020	1.2
5D	Amor-Cabba loams, 9 to 15 percent slopes	54,220	5.1
6	Arnegard loam, 1 to 3 percent slopes	17,330	1.6
6B	Arnegard loam, 3 to 6 percent slopes	5,970	0.6
7	Banks loam	6,940	0.6
8	Breien fine sandy loam	2,940	0.3
9	Bowdle loam, 1 to 3 percent slopes	10,290	1.0
10F	Cabba loam, 15 to 45 percent slopes	43,260	4.0
11F	Cabba-Brandenburg complex, 3 to 45 percent slopes	1,120	0.1
12C	Chama-Cabba silt loams, 6 to 9 percent slopes	13,170	1.2
12D	Chama-Cabba silt loams, 9 to 15 percent slopes	7,290	0.7
13F	Badland-Cabba complex, 3 to 120 percent slopes	3,180	0.3
15B	Daglum loam, 1 to 6 percent slopes	23,300	2.2
19F	Cabba loam, 15 to 45 percent slopes, extremely stony	3,990	0.4
20B	Desart fine sandy loam, 1 to 6 percent slopes	7,830	0.7
25C	Ekalaka-Lemert fine sandy loams, 1 to 9 percent slopes	19,190	1.8
30F	Flasher loamy fine sand, 15 to 45 percent slopes	61,540	5.8
31F	Flasher loamy fine sand, 15 to 45 percent slopes, extremely stony	6,340	0.6
33	Arveson fine sandy loam	3,240	0.3
35	Grail silty clay loam, 1 to 3 percent slopes	21,740	2.0
37	Grail-Belfield-Daglum complex, 1 to 3 percent slopes	26,360	2.4
40	Harriet loam, 1 to 3 percent slopes	12,700	1.2
41	Heil silty clay	2,310	0.2
42	Lawther silty clay, 1 to 3 percent slopes	2,060	0.2
44B	Lihen loamy fine sand, 1 to 6 percent slopes	5,910	0.6
46	Dumps and pits, mine	540	0.1
48B	Moreau clay loam, 3 to 6 percent slopes	8,420	0.8
48C	Moreau clay loam, 6 to 9 percent slopes	2,230	0.2
52	Regan clay loam, 0 to 3 percent slopes	9,180	0.9
53B	Regent silty clay loam, 3 to 6 percent slopes	46,210	4.3
53C	Regent silty clay loam, 6 to 9 percent slopes	9,590	0.9
54B	Regent-Rhoades complex, 3 to 6 percent slopes	16,590	1.6
54C	Regent-Rhoades complex, 6 to 9 percent slopes	1,820	0.2
55C	Rhoades-Daglum loams, 1 to 9 percent slopes	44,330	4.0
56B	Ruso fine sandy loam, 1 to 6 percent slopes	11,050	1.0
57B	Savage clay loam, 2 to 6 percent slopes	23,470	2.2
59D	Seroco-Blownout land complex, 3 to 15 percent slopes	1,390	0.1
60	Shambo loam, 1 to 3 percent slopes	22,600	2.1
60B	Shambo loam, 3 to 6 percent slopes	11,440	1.1
62B	Daglum Variant-Daglum loams, 1 to 6 percent slopes	1,620	0.2
63	Straw loam, 0 to 3 percent slopes	17,950	1.7
64	Straw loam, channeled	14,780	1.4
65B	Parshall fine sandy loam, 1 to 6 percent slopes	27,340	2.5
68C	Telfer-Seroco loamy fine sands, 1 to 9 percent slopes	9,450	0.9
70B	Beisigl-Lihen-Flasher loamy fine sands, 1 to 6 percent slopes	7,120	0.7
70D	Beisigl-Flasher loamy fine sands, 6 to 15 percent slopes	19,840	1.9
71B	Sen silt loam, 3 to 6 percent slopes	9,750	0.9
80B	Vebar-Parshall fine sandy loams, 1 to 6 percent slopes	80,890	7.6
80C	Vebar fine sandy loam, 6 to 9 percent slopes	52,480	4.8
83D	Vebar fine sandy loam, 6 to 15 percent slopes, very stony	3,840	0.4
84D	Vebar-Flasher complex, 6 to 15 percent slopes	59,750	5.5
90	Velva fine sandy loam, 0 to 3 percent slopes	11,730	1.1
91F	Schaller-Cabba complex, 3 to 45 percent slopes	17,200	1.6
101	Brisbane loam, 1 to 3 percent slopes	10,170	1.0
	Water	7,450	0.7
	Total	1,070,080	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Spring wheat	Barley	Oats	Flax	Sunflowers	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
1B----------------------- Amor	23	37	49	12	1,150	1.4
1C----------------------- Amor	16	26	34	8	800	1.4
3D. Amor-Cabba						
5D----------------------- Amor-Cabba	8	13	17	4	400	0.9
6------------------------ Arnegard	31	50	66	16	1,550	2.3
6B----------------------- Arnegard	27	44	57	14	1,350	1.8
7. Banks						
8------------------------ Breien	13	21	28	7	650	1.3
9------------------------ Bowdle	19	31	40	10	950	1.7
10F. Cabba						
11F. Cabba-Brandenburg						
12C---------------------- Chama-Cabba	13	21	28	7	650	1.0
12D---------------------- Chama-Cabba	9	15	19	5	450	1.0
13F. Badland-Cabba						
15B---------------------- Daglum	10	16	21	5	500	1.0
19F. Cabba						
20B---------------------- Desart	15	24	32	8	750	1.2
25C. Ekalaka-Lemert						
30F, 31F. Flasher						
33----------------------- Arveson	15	24	32	8	750	2.4
35----------------------- Grail	29	47	62	15	1,450	2.4

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Flax	Sunflowers	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
37------------------------ Grail-Belfield-Daglum	23	37	49	12	1,150	1.7
40. Harriet						
41. Heil						
42------------------------ Lawther	28	46	60	14	1,400	1.6
44B----------------------- Lihen	16	26	34	8	800	1.4
46*. Dumps and pits						
48B----------------------- Moreau	19	31	40	10	950	1.6
48C----------------------- Moreau	13	21	28	7	650	1.6
52------------------------ Regan	11	18	23	6	550	1.4
53B----------------------- Regent	21	34	45	11	1,050	1.4
53C----------------------- Regent	20	33	43	10	1,000	1.4
54B----------------------- Regent-Rhoades	17	28	36	9	850	1.2
54C----------------------- Regent-Rhoades	13	21	28	7	650	1.2
55C. Rhoades-Daglum						
56B----------------------- Ruso	15	24	32	8	750	1.4
57B----------------------- Savage	24	39	51	12	1,200	1.6
59D*. Seroco-Blownout land						
60------------------------ Shambo	27	44	57	14	1,350	1.7
60B----------------------- Shambo	26	42	55	13	1,300	1.7
62B----------------------- Daglum Variant-Daglum	11	18	23	6	550	1.0

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Flax	Sunflowers	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Lbs	Tons
63---------- Straw	29	47	62	15	1,450	1.7
64. Straw						
65B---------- Parshall	22	36	47	11	1,100	1.4
68C---------- Telfer-Seroco	---	---	---	---	---	1.0
70B---------- Beisigl-Lihen-Flasher	11	18	23	6	550	1.1
70D. Beisigl-Flasher						
71B---------- Sen	22	36	47	11	1,100	1.4
80B---------- Vebar-Parshall	20	33	43	10	1,000	1.4
80C---------- Vebar	15	24	32	8	750	1.2
83D. Vebar						
84D. Vebar-Flasher						
90---------- Velva	22	36	47	11	1,100	1.4
91F. Schaller-Cabba						
101---------- Brisbane	25	41	53	13	1,250	1.7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1B, 1C: Amor	Silty	2,300	2,000	1,700
3D*, 5D*:				
Amor	Silty	2,300	2,000	1,700
Cabba	Shallow	1,700	1,500	1,200
6: Arnegard	Overflow	3,400	2,900	2,400
6B: Arnegard	Silty	2,300	2,000	1,700
7: Banks	Sands	2,500	2,300	2,000
8: Breien	Sandy	2,400	2,100	1,800
9: Bowdle	Silty	2,300	2,000	1,700
10F: Cabba	Shallow	1,700	1,500	1,200
11F*:				
Cabba	Shallow	1,700	1,500	1,200
Brandenburg	Very Shallow	900	700	500
12C*, 12D*:				
Chama	Silty	2,300	2,000	1,700
Cabba	Shallow	1,700	1,500	1,200
13F*:				
Badland.				
Cabba	Shallow	1,700	1,500	1,200
15B: Daglum	Claypan	1,600	1,400	1,200
19F: Cabba	Shallow	1,700	1,500	1,200
20B: Desart	Sandy	2,400	2,100	1,800
25C*:				
Ekalaka	Sandy Claypan	2,700	2,000	1,300
Lemert	Thin Claypan	900	700	500
30F: Flasher	Shallow	1,700	1,500	1,200

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
31F------------------ Flasher	Shallow------------------	1,700	1,500	1,200
33------------------ Arveson	Subirrigated------------------	4,400	4,000	3,600
35------------------ Grail	Overflow------------------	3,400	2,900	2,400
37*:				
Grail------------------	Overflow------------------	3,400	2,900	2,400
Belfield------------------	Clayey------------------	2,300	2,000	1,700
Daglum------------------	Claypan------------------	1,600	1,400	1,200
40------------------ Harriet	Saline Lowland------------------	3,000	2,600	2,200
41------------------ Heil	Closed Depression------------------	3,000	2,600	2,200
42------------------ Lawther	Clayey------------------	2,300	2,000	1,700
44B------------------ Lihen	Sands------------------	2,500	2,300	2,000
48B, 48C------------------ Moreau	Clayey------------------	2,300	2,000	1,700
52------------------ Regan	Subirrigated------------------	4,400	4,000	3,600
53B, 53C------------------ Regent	Clayey------------------	2,300	2,000	1,700
54B*, 54C*:				
Regent------------------	Clayey------------------	2,300	2,000	1,700
Rhoades------------------	Thin Claypan------------------	900	700	500
55C*:				
Rhoades------------------	Thin Claypan------------------	900	700	500
Daglum------------------	Claypan------------------	1,600	1,400	1,200
56B------------------ Ruso	Sandy------------------	2,400	2,100	1,800
57B------------------ Savage	Clayey------------------	2,300	2,000	1,700
59D*:				
Seroco------------------	Thin Sands------------------	1,800	1,500	1,200
Blownout land.				

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
60, 60B Shambo	Silty	2,300	2,000	1,700
62B*:				
Daglum Variant	Claypan	1,600	1,400	1,200
Daglum	Claypan	1,600	1,400	1,200
63 Straw	Silty	2,300	2,000	1,700
64 Straw	Overflow	3,400	2,900	2,400
65B Parshall	Sandy	2,400	2,100	1,800
68C*:				
Telfer	Sands	2,500	2,300	2,000
Seroco	Thin Sands	1,800	1,500	1,200
70B*:				
Beisigl	Sands	2,500	2,300	2,000
Lihen	Sands	2,500	2,300	2,000
Flasher	Shallow	1,700	1,500	1,200
70D*:				
Beisigl	Sands	2,500	2,300	2,000
Flasher	Shallow	1,700	1,500	1,200
71B Sen	Silty	2,300	2,000	1,700
80B*:				
Vebar	Sandy	2,400	2,100	1,800
Parshall	Sandy	2,400	2,100	1,800
80C, 83D Vebar	Sandy	2,400	2,100	1,800
84D*:				
Vebar	Sandy	2,400	2,100	1,800
Flasher	Shallow	1,700	1,500	1,200
90 Velva	Sandy	2,400	2,100	1,800
91F*:				
Schaller	Very Shallow	900	700	500
Cabba	Shallow	1,700	1,500	1,200
101 Brisbane	Silty	2,300	2,000	1,700

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1B, 1C----------- Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
3D*: Amor.					
Cabba.					
5D*: Amor------------	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
Cabba.					
6, 6B------------ Arnegard	Peking cotoneaster, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, Black Hills spruce, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
7---------------- Banks	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
8---------------- Breien	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, common chokecherry, Black Hills spruce, eastern redcedar, Siberian crabapple, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
9. Bowdle	---	Ponderosa pine, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, green ash.	---	---
10F. Cabba					
11F*: Cabba.					
Brandenburg.					
12C*, 12D*: Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
Cabba.					
13F*: Badland.					
Cabba.					
15B. Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
19F. Cabba					
20B. Desart	Green ash, Russian-olive, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry, eastern redcedar.	Siberian elm, ponderosa pine.	---	---	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
25C*:					
Ekalaka	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
Lemert	Green ash, Russian-olive, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry, eastern redcedar.	Siberian elm, ponderosa pine.	---	---	---
30F, 31F. Flasher					
33 Arveson	American plum	Eastern redcedar, common chokecherry, lilac, Tatarian honeysuckle, redosier dogwood, Siberian peashrub.	Green ash, Siberian crabapple, Black Hills spruce.	Golden willow	Eastern cottonwood.
35 Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
37*:					
Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
37*:					
Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
40. Harriet					
41. Heil					
42 Lawther	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry, eastern redcedar.	Siberian elm	---	---
44B Lihen	American plum, silver buffaloberry.	Bur oak, Siberian crabapple, Siberian peashrub, common chokecherry, Tatarian honeysuckle, eastern redcedar, lilac.	Ponderosa pine, green ash, Russian-olive.	---	---
46*. Dumps and pits					
48B, 48C Moreau	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
52** Regan	Redosier dogwood, Siberian peashrub, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, lilac, common chokecherry.	Green ash	Golden willow	Plains cottonwood.
53B, 53C Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
54B*, 54C*:					
Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
Rhoades.					
55C*:					
Rhoades.					
Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
56B Ruso	---	Ponderosa pine, Siberian peashrub, Russian-olive, eastern redcedar, Rocky Mountain juniper.	Siberian elm, green ash.	---	---
57B Savage	---	Lilac, American elm, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, Black Hills spruce.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
59D*:					
Seroco	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
Blownout land.					
60, 60B Shambo	---	Black Hills spruce, eastern redcedar, Russian-olive, Siberian peashrub, common chokecherry, lilac, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
62B*: Daglum Variant.					
Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
63 Straw	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
64. Straw					
65B Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
68C*: Telfer	Tatarian honeysuckle, lilac, silver buffaloberry.	Eastern redcedar, bur oak, common chokecherry, Siberian crabapple, American plum, Siberian peashrub.	Ponderosa pine, green ash, Russian-olive.	---	---
Seroco	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
70B*: Beisigl	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
70B*:					
Lihen	American plum, silver buffaloberry.	Bur oak, Siberian crabapple, Siberian peashrub, common chokecherry, Tatarian honeysuckle, eastern redcedar, lilac.	Ponderosa pine, green ash, Russian-olive.	---	---
Flasher.					
70D*:					
Beisigl.					
Flasher.					
71B Sen	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
80B*:					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
80C Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
83D. Vebar					

See footnotes at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
84D*:					
Vebar	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
Flasher.					
90 Velva	Tatarian honeysuckle, American plum, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, Siberian peashrub, common chokecherry, eastern redcedar.	Golden willow, ponderosa pine.	Plains cottonwood	---
91F*:					
Schaller.					
Cabba.					
101 Brisbane	---	Black Hills spruce, Russian-olive, American plum, Tatarian honeysuckle, common chokecherry, eastern redcedar, Siberian peashrub, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.
** See description of the map unit for information on the effects of salinity on trees and shrubs.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1B-------------------- Amor	Slight---------------	Slight---------------	Moderate: slope, depth to rock.	Slight.
1C-------------------- Amor	Slight---------------	Slight---------------	Severe: slope.	Slight.
3D*:				
Amor------------------	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Slight.
Cabba-----------------	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope.	Moderate: large stones.
5D*:				
Amor------------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cabba-----------------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
6, 6B----------------- Arnegard	Slight---------------	Slight---------------	Moderate: slope.	Slight.
7--------------------- Banks	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
8--------------------- Breien	Severe: flooding.	Slight---------------	Slight---------------	Slight.
9--------------------- Bowdle	Slight---------------	Slight---------------	Moderate: slope.	Slight.
10F------------------- Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
11F*:				
Cabba-----------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Brandenburg-----------	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Moderate: slope.
12C*:				
Chama-----------------	Slight---------------	Slight---------------	Severe: slope.	Slight.
Cabba-----------------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
12D*:				
Chama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
13F*:				
Badland.				
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
15B Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
19F Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope.	Severe: slope.
20B Desart	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
25C*:				
Ekalaka	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Lemert	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
30F Flasher	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
31F Flasher	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: slope.
33 Arveson	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
35 Grail	Slight	Slight	Moderate: slope.	Slight.
37*:				
Grail	Slight	Slight	Moderate: slope.	Slight.
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
40 Harriet	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
41 Heil	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, excess sodium.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.
42 Lawther	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
44B Lihen	Slight	Slight	Moderate: slope.	Slight.
46*. Dumps and pits				
48B Moreau	Slight	Slight	Moderate: slope.	Slight.
48C Moreau	Slight	Slight	Severe: slope.	Slight.
52 Regan	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
53B Regent	Slight	Slight	Moderate: slope.	Slight.
53C Regent	Slight	Slight	Severe: slope.	Slight.
54B*:				
Regent	Slight	Slight	Moderate: slope.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
54C*:				
Regent	Slight	Slight	Severe: slope.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: slope, excess sodium.	Slight.
55C*:				
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
56B Ruso	Slight	Slight	Moderate: slope.	Slight.
57B Savage	Slight	Slight	Moderate: slope.	Severe: erodes easily.
59D*:				
Seroco	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
59D*: Blownout land.				
60, 60B: Shambo	Slight	Slight	Moderate: slope.	Slight.
62B*:				
Daglum Variant	Severe: percs slowly, depth to rock.	Severe: percs slowly, depth to rock.	Severe: depth to rock, percs slowly.	Slight.
Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
63: Straw	Severe: flooding.	Slight	Slight	Slight.
64: Straw	Severe: flooding.	Moderate: flooding.	Slight	Moderate: flooding.
65B: Parshall	Slight	Slight	Moderate: slope.	Slight.
68C*:				
Telfer	Slight	Slight	Moderate: slope.	Slight.
Seroco	Slight	Slight	Moderate: slope.	Slight.
70B*:				
Beisigl	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
Lihen	Slight	Slight	Moderate: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
70D*:				
Beisigl	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
71B: Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
80B*:				
Vebar	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Parshall	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
80C: Vebar	Slight	Slight	Severe: slope.	Slight.
83D: Vebar	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: large stones, slope.	Slight.
84D*:				
Vebar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
90: Velva	Severe: flooding.	Slight	Moderate: flooding.	Slight.
91F*:				
Schaller	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
101: Brisbane	Slight	Slight	Moderate: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1B, 1C Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
3D*:									
Amor	Poor	Poor	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Cabba	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
5D*:									
Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
6 Arnegard	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
6B Arnegard	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
7 Banks	Fair	Good	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
8 Breien	Fair	Good	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
9 Bowdle	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
10F Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
11F*:									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Brandenburg	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
12C*, 12D*:									
Chama	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
13F*:									
Badland.									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
15B Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
19F Cabba	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
20B Desart	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--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
25C*:									
Ekalaka	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
Lemert	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
30F Flasher	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
31F Flasher	Very poor	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
33 Arveson	Good	Good	Fair	Fair	Good	Good	Fair	Good	Fair.
35 Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
37*:									
Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
40 Harriet	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
41 Heil	Poor	Poor	Poor	Very poor	Poor	Good	Poor	Fair	Very poor.
42 Lawther	Good	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
44B Lihen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
46* Dumps and pits									
48B Moreau	Fair	Good	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
48C Moreau	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
52 Regan	Good	Good	Good	Fair	Good	Good	Good	Good	Fair.
53B, 53C Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
54B*, 54C*:									
Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--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
55C*:									
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
56B Ruso	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
57B Savage	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
59D*:									
Seroco	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
Blownout land.									
60, 60B Shambo	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
62B*:									
Daglum Variant	Fair	Fair	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
63 Straw	Good	Good	Good	Good	Good	Good	Good	Good	Good.
64 Straw	Very poor	Very poor	Good	Good	Good	Good	Poor	Good	Good.
65B Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
68C*:									
Telfer	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Seroco	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
70B*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Lihen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
70D*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
71B Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
80B*:									
Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--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
80C----------------- Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
83D----------------- Vebar	Poor	Poor	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
84D*:									
Vebar--------------	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Good.
Flasher------------	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
90------------------ Velva	Fair	Good	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
91F*:									
Schaller-----------	Very poor	Very poor	Fair	Good	Very poor	Very poor	Very poor	Very poor	Fair.
Cabba--------------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
101----------------- Brisbane	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1B, 1C----------- Amor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
3D*:					
Amor-------------	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.
5D*:					
Amor-------------	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, shrink-swell, slope.
6---------------- Arnegard	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell.	Severe: low strength.
6B--------------- Arnegard	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell, slope.	Severe: low strength.
7---------------- Banks	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
8---------------- Breien	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
9---------------- Bowdle	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
10F-------------- Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
11F*:					
Cabba------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Brandenburg------	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
12C*:					
Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cabba	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
12D*:					
Chama	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cabba	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, shrink-swell, slope.
13F*:					
Badland.					
Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
15B Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
19F Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
20B Desart	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
25C*:					
Ekalaka	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Lemert	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
30F, 31F Flasher	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
33 Arveson	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.
35 Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
37*:					
Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
37*:					
Belfield	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
40 Harriet	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, low strength.
41 Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
42 Lawther	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
44B Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
46*. Dumps and pits					
48B, 48C Moreau	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
52 Regan	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
53B, 53C Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
54B*, 54C*:					
Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
55C*:					
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
56B Ruso	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
57B: Savage	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
59D*:					
Seroco	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Blownout land.					
60: Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
60B: Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
62B*:					
Daglum Variant	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
63: Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
64: Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
65B: Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
68C*:					
Telfer	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Seroco	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
70B*:					
Beisigl	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Flasher	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
70D*:					
Beisigl	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
70D*:					
Flasher----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
71B-------------- Sen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
80B*:					
Vebar------------	Severe: cutbanks cave.	Slight-----------	Moderate: depth to rock.	Slight------------	Slight.
Parshall---------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
80C-------------- Vebar	Severe: cutbanks cave.	Slight-----------	Moderate: depth to rock.	Moderate: slope.	Slight.
83D-------------- Vebar	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
84D*:					
Vebar------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Flasher----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
90--------------- Velva	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
91F*:					
Schaller---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cabba------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
101-------------- Brisbane	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell.	Moderate: low strength, frost action, shrink-swell.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1B------------------- Amor	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
1C------------------- Amor	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
3D*: Amor----------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba---------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
5D*: Amor----------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba---------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
6, 6B--------------- Arnegard	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey, too sandy.	Slight-----------	Fair: too clayey, too sandy.
7-------------------- Banks	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
8-------------------- Breien	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
9-------------------- Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
10F------------------ Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
11F*: Cabba---------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11F*:					
Brandenburg--------	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
12C*, 12D*:					
Chama--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba--------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
13F*:					
Badland.					
Cabba--------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
15B---------------- Daglum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, excess sodium.
19F---------------- Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
20B---------------- Desart	Severe: percs slowly.	Severe: seepage.	Severe: depth to rock, seepage, too sandy.	Severe: seepage.	Poor: too sandy, excess sodium.
25C*:					
Ekalaka------------	Severe: percs slowly.	Severe: seepage.	Severe: seepage, too sandy, excess sodium.	Severe: seepage.	Poor: too sandy, excess sodium.
Lemert-------------	Slight------------	Severe: seepage.	Severe: seepage, excess sodium.	Severe: seepage.	Poor: excess sodium.
30F, 31F----------- Flasher	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
33----------------- Arveson	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
35----------------- Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
37*:					
Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Daglum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, excess sodium.
40 Harriet	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess sodium.
41 Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
42 Lawther	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
44B Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
46*. Dumps and pits					
48B Moreau	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
48C Moreau	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
52 Regan	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
53B Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
53C Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
54B*:					
Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Rhoades	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
54C*:					
Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Rhoades	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
55C*:					
Rhoades	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack.
Daglum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, excess sodium.
56B Ruso	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
57B Savage	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
59D*:					
Seroco	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Blownout land.					
60, 60B Shambo	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
62B*:					
Daglum Variant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Daglum	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, excess sodium.
63 Straw	Moderate: flooding, percs slowly.	Severe: seepage.	Severe: seepage.	Moderate: flooding.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
64 Straw	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
65B Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
68C*:					
Telfer	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Seroco	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
70B*:					
Beisigl	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
70D*:					
Beisigl	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Flasher	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
71B Sen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
80B*:					
Vebar	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
80C, 83D Vebar	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
84D*:					
Vebar	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
84D*:					
Flasher	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
90 Velva	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
91F*:					
Schaller	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
101 Brisbane	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1B, 1C Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
3D*:				
Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Cabba	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
5D*:				
Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
6, 6B Arnegard	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
7 Banks	Good	Probable	Improbable: too sandy.	Good.
8 Breien	Good	Probable	Improbable: too sandy.	Poor: thin layer.
9 Bowdle	Good	Probable	Probable	Fair: area reclaim.
10F Cabba	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
11F*:				
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Brandenburg	Poor: large stones.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim, slope.
12C*:				
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
12D*:				
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, slope.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
13F*:				
Badland.				
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
15B Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
19F Cabba	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
20B Desart	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
25C*:				
Ekalaka	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Lemert	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
30F Flasher	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
31F Flasher	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones, slope.
33 Arveson	Fair: wetness.	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
35 Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
37*:				
Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
37*:				
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
40 Harriet	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
41 Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, excess sodium.
42 Lawther	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
44B Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
46*. Dumps and pits				
48B, 48C Moreau	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
52 Regan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
53B, 53C Regent	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
54B*, 54C*:				
Regent	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
55C*:				
Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
56B Ruso	Good	Probable	Probable	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
57B----------------- Savage	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
59D*:				
Seroco---------------	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
Blownout land.				
60, 60B-------------- Shambo	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
62B*:				
Daglum Variant-------	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
Daglum---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
63, 64--------------- Straw	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
65B------------------ Parshall	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
68C*:				
Telfer---------------	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Seroco---------------	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
70B*:				
Beisigl--------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Lihen----------------	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Flasher--------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
70D*:				
Beisigl--------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Flasher--------------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
71B------------------ Sen	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
80B*:				
Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
80C Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
83D Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, slope.
84D*:				
Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, slope.
Flasher	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
90 Velva	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
91F*:				
Schaller	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
101 Brisbane	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
1B, 1C Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
3D*:						
Amor	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, excess salt.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
5D*:						
Amor	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
6 Arnegard	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
6B Arnegard	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
7 Banks	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty	Too sandy	Droughty.
8 Breien	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
9 Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
10F Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
11F*:						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Brandenburg	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
12C*:						
Chama	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
12D*:						
Chama	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
13F*:						
Badland.						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
15B Daglum	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
19F Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, excess salt.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
20B Desart	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Soil blowing	Too sandy, soil blowing.	Excess sodium.
25C*:						
Ekalaka	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Excess sodium, droughty.
Lemert	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Droughty, soil blowing, percs slowly.	Soil blowing	Excess sodium, droughty, percs slowly.
30F Flasher	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
31F Flasher	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope.
33 Arveson	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
35 Grail	Slight	Moderate: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
37*:						
Grail	Slight	Moderate: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.
Belfield	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Daglum	Slight	Severe: excess sodium.	Deep to water	Percs slowly	Percs slowly	Excess sodium, percs slowly.
40 Harriet	Slight	Severe: piping, wetness, excess sodium.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
41 Heil	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
42 Lawther	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Excess salt, percs slowly.
44B Lihen	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
46*. Dumps and pits						
48B, 48C Moreau	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
52 Regan	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding, excess salt.	Wetness	Wetness.
53B, 53C Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
54B*, 54C*:						
Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Rhoades	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
55C*:						
Rhoades	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
Daglum	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
56B Ruso	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
57B: Savage	Moderate: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
59D*:						
Seroco	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Blownout land.						
60: Shambo	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
60B: Shambo	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
62B*:						
Daglum Variant	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Daglum	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
63: Straw	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
64: Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
65B: Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
68C*:						
Telfer	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Seroco	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
70B*:						
Beisigl	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, too sandy.	Droughty, depth to rock.
Lihen	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Flasher	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, soil blowing.	Droughty, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
70D*:						
Beisigl----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Flasher----------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
71B--------------- Sen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
80B*:						
Vebar------------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Parshall---------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
80C--------------- Vebar	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
83D--------------- Vebar	Severe: seepage, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
84D*:						
Vebar------------	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Flasher----------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
90---------------- Velva	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
91F*:						
Schaller---------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
Cabba------------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
101--------------- Brisbane	Severe: seepage.	Severe: piping, seepage.	Deep to water	Favorable------	Too sandy------	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1B, 1C-----------Amor	0-6	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	25-40	3-18
	6-37	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	75-100	50-95	20-45	2-25
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
3D*:											
Amor------------	0-6	Very stony loam	CL, CL-ML	A-4, A-6	3-25	100	95-100	90-100	65-85	20-40	5-20
	6-37	Clay loam, loam, fine sandy loam.	CL, CL-ML	A-4, A-6, A-7	0-20	100	95-100	75-100	50-95	20-45	5-30
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-3	Very stony loam	CL-ML, CL	A-4, A-6	15-40	80-100	75-100	60-85	50-75	20-35	5-15
	3-10	Gravelly loam, silt loam, silty clay loam.	CL, CL-ML, SM-SC, GM-GC	A-4, A-6	0-10	60-100	55-100	50-100	45-95	25-35	5-15
	10-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
5D*:											
Amor------------	0-6	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	25-40	3-18
	6-37	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	75-100	50-95	20-45	2-25
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-10	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
6, 6B------------Arnegard	0-18	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	20-35	5-20
	18-47	Loam, silt loam, clay loam.	CL	A-6	0	100	100	85-100	50-90	25-40	12-25
	47-60	Loam, clay loam, loamy fine sand.	SM, ML, CL, SC	A-4, A-6	0	100	100	70-100	40-80	15-40	NP-15
7----------------Banks	0-4	Loam-------------	SM, ML	A-4	0	100	100	80-95	45-75	20-40	NP-10
	4-60	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2	0	100	100	50-70	10-25	---	NP
8----------------Breien	0-6	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4	0	90-100	90-100	70-95	35-65	15-25	NP-5
	6-15	Fine sandy loam, loam.	SM, ML, SC, CL	A-4, A-6	0	90-100	90-100	70-95	35-75	15-35	NP-15
	15-60	Stratified fine sand to sand.	SM, SP-SM	A-2, A-3	0	90-100	90-100	65-85	5-25	---	NP
9----------------Bowdle	0-8	Loam-------------	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	8-23	Loam, clay loam	CL, CL	A-4, A-6	0	95-100	90-100	70-95	50-75	30-40	8-15
	23-28	Gravelly loam, sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	90-100	80-100	60-95	30-60	25-35	5-10
	28-60	Very gravelly sand, gravelly loamy sand, very gravelly loamy sand.	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
10F-------------- Cabba	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-10	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
11F*:											
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-10	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Brandenburg-----	0-10	Channery loam----	CL-ML, GM-GC, CL, SM-SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	5-15
	10-60	Fragmental material.	GP	A-1	80-85	15-25	5-10	0-5	0	---	NP
12C*, 12D*:											
Chama-----------	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	6-34	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-50	5-25
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-4	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	4-14	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
13F*: Badland.											
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-10	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
15B-------------- Daglum	0-10	Loam-------------	SM, ML, CL-ML, SM-SC	A-4	0	100	100	75-90	45-65	20-30	3-10
	10-20	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	20-60	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
19F-------------- Cabba	0-3	Extremely stony loam.	ML, CL-ML, SM, SM-SC	A-4	40-45	95-100	90-100	65-85	45-65	15-30	NP-10
	3-10	Gravelly loam, silt loam, silty clay loam.	CL, CL-ML, SM-SC, GM-GC	A-4, A-6	0-10	60-100	55-100	50-100	45-95	25-35	5-15
	10-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
20B-------------- Desart	0-25	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-50	20-35	NP-10
	25-30	Fine sandy loam, loam, very fine sandy loam.	SM, ML	A-2, A-4	0	100	100	70-100	30-65	<40	NP-10
	30-48	Loamy fine sand, fine sand, loam.	SM, ML	A-2, A-4	0	100	100	50-100	25-65	<35	NP-10
	48-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
25C*:											
Ekalaka----------	0-12	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	70-85	30-60	20-35	NP-10
	12-21	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	100	70-100	30-70	20-35	NP-10
	21-60	Fine sandy loam, loamy fine sand, fine sand.	SM, SC, SM-SC	A-2, A-4, A-6	0	100	100	50-100	30-40	20-40	NP-15
Lemert----------	0-5	Fine sandy loam	SM, ML, SC, CL	A-2, A-4, A-6	0	100	100	80-100	30-60	<25	NP-5
	5-16	Fine sandy loam	SM, ML, SC, CL	A-4, A-6, A-2	0	100	100	80-100	30-60	<25	NP-5
	16-60	Loamy fine sand, fine sandy loam.	SM, SC, ML, CL	A-2, A-4, A-6, A-7	0	100	100	80-100	20-60	<25	NP-5
30F-------------- Flasher	0-6	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-10	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
31F-------------- Flasher	0-3	Extremely stony loamy fine sand.	SM	A-2	3-25	85-100	85-100	50-100	15-35	---	NP
	3-10	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-20	85-100	85-100	50-100	15-35	---	NP
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
33--------------- Arveson	0-6	Fine sandy loam	SM	A-2-4, A-4	0-1	100	95-100	55-85	30-50	<30	NP-7
	6-21	Fine sandy loam, sandy loam, loam.	SM, SM-SC	A-4	0	100	95-100	60-85	35-50	<20	NP-5
	21-60	Fine sand, loamy sand, sandy loam.	SP-SM, SM, SM-SC	A-3, A-2, A-4	0	100	95-100	50-80	5-45	<20	NP-5
35--------------- Grail	0-8	Silty clay loam	CL	A-6, A-7	0	100	95-100	95-100	85-95	30-50	10-30
	8-36	Silty clay, silty clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	95-100	95-100	70-95	35-60	10-35
	36-60	Loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-95	30-55	10-30
37*:											
Grail-----------	0-8	Silty clay loam	CL	A-6, A-7	0	100	95-100	95-100	85-95	30-50	10-30
	8-36	Silty clay, silty clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	95-100	95-100	70-95	35-60	10-35
	36-60	Loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-95	30-55	10-30
Belfield--------	0-12	Loam-------------	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	12-24	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	24-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
37*:											
Daglum----------	0-10	Loam------------	SM, ML, CL-ML, SM-SC	A-4	0	100	100	75-90	45-65	20-30	3-10
	10-20	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	20-60	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
40--------------- Harriet	0-2	Loam------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-10	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-100	35-70	20-40
	10-60	Stratified very fine sandy loam to silty clay.	CL, CL-ML, CH	A-4, A-6, A-7	0	100	100	90-100	60-100	20-65	5-40
41--------------- Heil	0-2	Silty clay-------	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	2-26	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	26-60	Silty clay, silty clay loam, loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
42--------------- Lawther	0-5	Silty clay-------	CL, CH	A-7	0	100	100	90-100	75-100	45-70	25-40
	5-33	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
	33-60	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
44B-------------- Lihen	0-14	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	14-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
46* Dumps and pits											
48B, 48C--------- Moreau	0-5	Clay loam--------	CL, CH	A-7, A-6	0	100	100	90-100	70-95	30-60	15-40
	5-12	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	12-21	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	21-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
52--------------- Regan	0-20	Clay loam--------	CL	A-7, A-6	0	100	100	90-100	80-95	36-50	10-30
	20-60	Stratified sandy loam to silty clay loam.	ML, CL, SC, SM	A-7, A-6, A-4	0	100	100	65-100	35-95	15-50	NP-30
53B, 53C--------- Regent	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	6-35	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	35-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
54B*:											
Regent----------	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	4-33	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
54B*:											
Rhoades	0-6	Loam	SM, ML, SC, CL	A-4, A-6	0	100	100	75-90	45-65	20-35	NP-15
	6-18	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	18-38	Silty clay, clay loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
54C*:											
Regent	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	6-31	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rhoades	0-5	Loam	SM, ML, SC, CL	A-4, A-6	0	100	100	75-90	45-65	20-35	NP-15
	5-16	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	16-38	Silty clay, clay loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
55C*:											
Rhoades	0-5	Loam	SM, ML, SC, CL	A-4, A-6	0	100	100	75-90	45-65	20-35	NP-15
	5-16	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	16-60	Silty clay, clay loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
Daglum	0-10	Loam	SM, ML, CL-ML, SM-SC	A-4	0	100	100	75-90	45-65	20-30	3-10
	10-20	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	20-60	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
56B Ruso	0-5	Fine sandy loam	SM	A-2, A-4	0-1	95-100	95-100	60-70	30-40	---	NP
	5-24	Coarse sandy loam, sandy loam.	SM	A-2, A-4	0-1	85-100	85-100	60-70	30-40	---	NP
	24-60	Sand and gravel	SP, SM, GM, GP	A-1, A-2	0-5	25-75	15-65	10-40	3-35	---	NP
57B Savage	0-6	Clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-30
	6-17	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	17-47	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	47-60	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
59D*:											
Seroco	0-7	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	7-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	100	65-80	20-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
59D*: Blownout land.											
60, 60B---------- Shambo	0-13	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	13-42	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	42-60	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
62B*: Daglum Variant--	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0-5	100	100	90-100	65-85	20-35	NP-15
	8-19	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	19-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Daglum----------	0-9	Loam-------------	SM, ML, CL-ML, SM-SC	A-4	0	100	100	75-90	45-65	20-30	3-10
	9-18	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-34	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
63, 64---------- Straw	0-8	Loam-------------	CL-ML	A-4	0	95-100	90-100	85-100	60-90	20-30	5-10
	8-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	60-85	25-40	5-20
65B-------------- Parshall	0-9	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	9-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
68C*: Telfer----------	0-5	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	5-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
Seroco----------	0-7	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	7-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	100	65-80	20-35	---	NP
70B*: Beisigl---------	0-6	Loamy fine sand	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	6-21	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	21-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lihen-----------	0-14	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	14-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
70B*:											
Flasher	0-6	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-10	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
70D*:											
Beisigl	0-6	Loamy fine sand	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	6-21	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	21-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher	0-6	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-10	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
71B Sen	0-6	Silt loam	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	6-33	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	85-100	60-95	25-45	10-30
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
80B*:											
Vebar	0-24	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	24-31	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Parshall	0-9	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	9-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
80C Vebar	0-24	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	24-31	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
83D Vebar	0-6	Very stony fine sandy loam.	SM, ML	A-4, A-2	3-25	95-100	90-100	60-100	30-55	---	NP
	6-31	Fine sandy loam, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
84D*:											
Vebar	0-24	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	24-31	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	31-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher	0-6	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	6-10	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
90--------------- 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, very fine sandy loam, loam.	ML, SM	A-4	0	100	100	70-95	40-75	20-30	NP-5
91F*: Schaller---------	0-9	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-2, A-4	0	95-100	95-100	55-85	25-55	10-25	NP-7
	9-15	Loamy fine sand, gravelly coarse sand.	SM, SP-SM, GM, GP-GM	A-1, A-2, A-3	0-5	55-100	50-90	40-70	5-20	0-20	NP-5
	15-60	Gravelly sand, gravelly coarse sand, sand.	GM, SM, GP-GM, SP-SM	A-1, A-3, A-2-4	0-5	55-90	50-90	40-70	5-15	0-20	NP-5
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-10	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
101-------------- Brisbane	0-6	Loam-------------	ML, CL, SM, SC	A-4, A-2	0	100	100	60-95	30-75	20-30	NP-10
	6-17	Loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	60-80	25-50	5-30
	17-31	Clay loam, loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7, A-2	0	100	95-100	65-100	30-80	20-50	5-30
	31-60	Sand, fine sand	SM, SP-SM	A-2	0-5	95-100	90-100	65-100	10-35	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
1B, 1C-----------	0-6	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
Amor	6-37	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	37-60	---	---	---	---	----------	----		
3D*:									
Amor------------	0-6	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.20	4	8
	6-37	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	37-60	---	---	---	---	----------	----		
Cabba-----------	0-3	0.6-2.0	0.12-0.16	6.6-8.4	<4	Moderate	0.17	2	8
	3-1	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.32		
	10-60	---	---	---	---	----------	----		
5D*:									
Amor------------	0-6	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
	6-37	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	37-60	---	---	---	---	----------	----		
Cabba-----------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	10-60	---	---	---	---	----------	----		
6, 6B------------	0-18	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.28	5	6
Arnegard	18-47	0.6-2.0	0.16-0.22	6.1-7.8	<2	Moderate	0.28		
	47-60	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low-------	0.28		
7----------------	0-4	2.0-6.0	0.14-0.21	6.6-7.8	<2	Low-------	0.24	5	5
Banks	4-60	6.0-20	0.07-0.09	7.4-8.4	<2	Low-------	0.17		
8----------------	0-6	0.6-6.0	0.13-0.18	6.6-7.8	<2	Low-------	0.20	5	3
Breien	6-15	0.6-6.0	0.15-0.17	6.6-7.8	<2	Low-------	0.20		
	15-60	6.0-20	0.07-0.09	7.4-8.4	<2	Low-------	0.17		
9----------------	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-------	0.28	4	6
Bowdle	8-23	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-------	0.28		
	23-28	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low-------	0.28		
	28-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-------	0.10		
10F--------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
Cabba	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	10-60	---	---	---	---	----------	----		
11F*:									
Cabba-----------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	10-60	---	---	---	---	----------	----		
Brandenburg-----	0-10	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low-------	0.24	2	8
	10-60	>20	0.01-0.03	6.6-8.4	<2	Low-------	0.10		
12C*, 12D*:									
Chama-----------	0-6	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	6-34	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	34-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
12C*, 12D*:									
Cabba-----------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	4-14	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	14-60	---	---	---	---	-----------	----		
13F*:									
Badland.									
Cabba-----------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	10-60	---	---	---	---	-----------	----		
15B-------------- Daglum	0-10	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	10-20	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	20-60	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
19F-------------- Cabba	0-3	0.6-2.0	0.12-0.16	6.6-8.4	<4	Low-------	0.17	2	8
	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.32		
	10-60	---	---	---	---	-----------	----		
20B-------------- Desart	0-25	2.0-6.0	0.13-0.15	6.1-8.4	<2	Low-------	0.20	4	3
	25-30	0.06-0.2	0.12-0.14	8.5-9.0	2-8	Low-------	0.32		
	30-48	0.06-6.0	0.08-0.10	7.9-9.0	4-16	Low-------	0.32		
	48-60	---	---	---	---	-----------	----		
25C*:									
Ekalaka---------	0-12	2.0-6.0	0.13-0.20	5.1-8.4	<2	Low-------	0.24	3	3
	12-21	0.06-0.2	0.11-0.13	7.4-9.0	2-8	Low-------	0.24		
	21-60	0.06-6.0	0.06-0.08	7.4-9.0	4-16	Low-------	0.24		
Lemert----------	0-5	2.0-6.0	0.13-0.18	5.1-8.4	<2	Low-------	0.24	3	3
	5-16	0.06-0.2	0.10-0.11	6.6-9.0	2-8	Low-------	0.24		
	16-60	2.0-6.0	0.05-0.09	7.4-9.0	4-16	Low-------	0.24		
30F-------------- Flasher	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	2
	6-10	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	10-60	---	---	---	---	-----------	----		
31F-------------- Flasher	0-3	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	8
	3-10	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	10-60	---	---	---	---	-----------	----		
33--------------- Arveson	0-6	2.0-6.0	0.13-0.15	7.4-8.4	<2	Low-------	0.17	4	3
	6-21	0.6-6.0	0.15-0.17	7.4-8.4	<2	Low-------	0.24		
	21-60	2.0-20	0.05-0.15	7.4-8.4	<2	Low-------	0.17		
35--------------- Grail	0-8	0.2-0.6	0.20-0.23	6.1-8.4	<2	Moderate	0.32	5	7
	8-36	0.06-0.6	0.14-0.17	6.6-8.4	<2	High------	0.32		
	36-60	0.06-0.6	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
37*:									
Grail-----------	0-8	0.2-0.6	0.20-0.23	6.1-8.4	<2	Moderate	0.32	5	7
	8-36	0.06-0.6	0.14-0.17	6.6-8.4	<2	High------	0.32		
	36-60	0.06-0.6	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
Belfield--------	0-12	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.32	3	6
	12-24	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	24-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
37*:									
Daglum----------	0-10	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	10-20	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	20-60	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
40--------------- Harriet	0-2	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate	0.37	3	6
	2-10	<0.06	0.10-0.15	>7.3	4-16	High------	0.37		
	10-60	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate	0.37		
41--------------- Heil	0-2	<0.06	0.13-0.18	5.6-7.3	<2	High------	0.28	3	4
	2-26	<0.06	0.13-0.18	6.6-9.0	4-16	High------	0.28		
	26-60	<0.06	0.13-0.18	7.4-9.0	4-16	High------	0.28		
42--------------- Lawther	0-5	0.06-0.2	0.14-0.17	6.6-8.4	<2	High------	0.32	5	4
	5-33	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	33-60	0.06-0.2	0.14-0.17	7.9-9.0	4-12	High------	0.32		
44B-------------- Lihen	0-14	6.0-20	0.10-0.12	6.1-7.8	<2	Low-------	0.17	5	2
	14-60	6.0-20	0.06-0.10	6.6-8.4	<2	Low-------	0.17		
46*. Dumps and pits									
48B, 48C--------- Moreau	0-5	0.2-0.6	0.18-0.23	7.4-9.0	<2	High------	0.32	4	4L
	5-12	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	12-21	0.06-0.2	0.13-0.15	7.4-9.0	2-16	High------	0.32		
	21-60	---	---	---	---	----------	----		
52--------------- Regan	0-20	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.32	5	4L
	20-60	0.2-2.0	0.14-0.17	7.4-9.0	<8	Moderate	0.32		
53B, 53C--------- Regent	0-6	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	6-35	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	35-60	---	---	---	---	----------	----		
54B*:									
Regent----------	0-4	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	4-33	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	33-60	---	---	---	---	----------	----		
Rhoades---------	0-6	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	6-18	<0.2	0.10-0.12	>6.5	2-16	High------	0.32		
	18-38	<0.2	0.10-0.12	>7.3	8-16	High------	0.32		
	38-60	---	---	---	---	----------	----		
54C*:									
Regent----------	0-6	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	6-31	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	31-60	---	---	---	---	----------	----		
Rhoades---------	0-5	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	5-16	<0.2	0.10-0.12	>6.5	2-16	High------	0.32		
	16-38	<0.2	0.10-0.12	>7.3	8-16	High------	0.32		
	38-60	---	---	---	---	----------	----		
55C*:									
Rhoades---------	0-5	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	5-16	<0.2	0.10-0.12	>6.5	2-16	High------	0.32		
	16-60	<0.2	0.10-0.12	>7.3	8-16	High------	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
55C*:									
Daglum----------	0-10	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	10-20	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	20-60	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
56B--------------	0-5	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low-------	0.20	4	3
Ruso	5-24	2.0-6.0	0.11-0.15	6.6-7.3	<2	Low-------	0.20		
	24-60	>20	0.02-0.04	7.4-8.4	<2	Low-------	0.10		
57B--------------	0-6	0.6-2.0	0.18-0.23	6.1-7.8	<2	Moderate	0.37	5	7
Savage	6-17	0.06-0.6	0.12-0.20	6.6-7.8	<2	High------	0.37		
	17-47	0.06-0.6	0.12-0.20	7.4-8.4	2-4	High------	0.37		
	47-60	0.06-0.6	0.12-0.20	7.4-8.4	4-8	High------	0.37		
59D*:									
Seroco----------	0-7	6.0-20	0.10-0.12	6.1-7.3	<2	Low-------	0.15	5	2
	7-60	6.0-20	0.06-0.08	6.6-8.4	<2	Low-------	0.15		
Blownout land.									
60, 60B----------	0-13	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-------	0.28	5	6
Shambo	13-42	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	0.28		
	42-60	0.6-2.0	0.17-0.19	7.4-9.0	<2	Moderate	0.28		
62B*:									
Daglum Variant--	0-8	0.6-2.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	8-19	<0.2	0.12-0.14	6.6-9.0	2-8	High------	0.32		
	19-60	---	---	---	---	----------	----		
Daglum----------	0-9	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low-------	0.32	3	6
	9-18	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	18-34	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
	34-60	---	---	---	---	----------	----		
63, 64-----------	0-8	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low-------	0.32	5	5
Straw	8-60	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.32		
65B--------------	0-9	2.0-6.0	0.16-0.18	5.6-8.4	<2	Low-------	0.20	5	3
Parshall	9-60	2.0-6.0	0.12-0.17	5.6-8.4	<2	Low-------	0.20		
68C*:									
Telfer----------	0-5	6.0-20	0.10-0.12	6.1-7.3	<2	Low-------	0.17	5	2
	5-60	6.0-20	0.06-0.10	6.6-7.8	<2	Low-------	0.17		
Seroco----------	0-7	6.0-20	0.10-0.12	6.1-7.3	<2	Low-------	0.15	5	2
	7-60	6.0-20	0.06-0.08	6.6-8.4	<2	Low-------	0.15		
70B*:									
Beisigl---------	0-6	6.0-20	0.11-0.13	6.6-8.4	<2	Low-------	0.17	4	2
	6-21	6.0-20	0.05-0.10	7.4-8.4	<2	Low-------	0.17		
	21-60	---	---	---	---	----------	----		
Lihen-----------	0-14	6.0-20	0.10-0.12	6.1-7.8	<2	Low-------	0.17	5	2
	14-60	6.0-20	0.06-0.10	6.6-8.4	<2	Low-------	0.17		
Flasher---------	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	2
	6-10	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	10-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
70D*:									
Beisigl----------	0-6	6.0-20	0.11-0.13	6.6-8.4	<2	Low--------	0.17	4	2
	6-21	6.0-20	0.05-0.10	7.4-8.4	<2	Low--------	0.17		
	21-60	---	---	---	---	----------	----		
Flasher----------	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17	2	2
	6-10	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17		
	10-60	---	---	---	---	----------	----		
71B-------------- Sen	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.32	4	6
	6-33	0.6-2.0	0.16-0.22	6.6-9.0	<2	Moderate	0.43		
	33-60	---	---	---	---	----------	----		
80B*:									
Vebar------------	0-24	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low--------	0.20	4	3
	24-31	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.20		
	31-60	---	---	---	---	----------	----		
Parshall---------	0-9	2.0-6.0	0.16-0.18	5.6-8.4	<2	Low--------	0.20	5	3
	9-60	2.0-6.0	0.12-0.17	5.6-8.4	<2	Low--------	0.20		
80C-------------- Vebar	0-24	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low--------	0.20	4	3
	24-31	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.20		
	31-60	---	---	---	---	----------	----		
83D-------------- Vebar	0-6	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low--------	0.20	4	8
	6-31	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low--------	0.20		
	31-60	---	---	---	---	----------	----		
84D*:									
Vebar------------	0-24	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low--------	0.20	4	3
	24-31	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.20		
	31-60	---	---	---	---	----------	----		
Flasher----------	0-6	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17	2	2
	6-10	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17		
	10-60	---	---	---	---	----------	----		
90--------------- Velva	0-6	0.6-6.0	0.13-0.22	6.6-7.8	<2	Low--------	0.20	5	3
	6-60	0.6-6.0	0.16-0.22	6.6-8.4	<2	Low--------	0.20		
91F*:									
Schaller---------	0-9	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low--------	0.20	5	3
	9-15	>20	0.02-0.04	6.6-7.8	<2	Low--------	0.20		
	15-60	>20	0.02-0.04	6.6-7.8	<2	Low--------	0.20		
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	3-10	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	10-60	---	---	---	---	----------	----		
101-------------- Brisbane	0-6	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low--------	0.28	4	6
	6-17	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28		
	17-31	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate	0.28		
	31-60	6.0-20	0.07-0.09	7.4-8.4	<2	Low--------	0.15		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1B, 1C------------ Amor	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
3D*, 5D*:												
Amor-------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
Cabba------------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
6, 6B------------- Arnegard	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
7----------------- Banks	A	Frequent----	Brief-----	Mar-Jun	>6.0	---	---	>60	---	Low------	Moderate	Low.
8----------------- Breien	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
9----------------- Bowdle	B	None---------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
10F--------------- Cabba	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
11F*:												
Cabba------------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
Brandenburg------	A	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
12C*, 12D*:												
Chama------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Cabba------------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
13F*: Badland.												
Cabba------------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
15B--------------- Daglum	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
19F--------------- Cabba	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	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	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
20B Desart	C	None	---	---	>6.0	---	---	40-60	Soft	Moderate	High	Moderate.
25C*:												
Ekalaka	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
Lemert	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
30F, 31F Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
33 Arveson	B/D	None	---	---	1.0-2.0	Apparent	Apr-Jul	>60	---	High	High	Low.
35 Grail	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
37*:												
Grail	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Belfield	C	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Daglum	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
40 Harriet	D	Occasional	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High	High	Moderate.
41 Heil	D	None	---	---	+1-1.0	Apparent	Mar-Sep	>60	---	Moderate	High	Moderate.
42 Lawther	D	None	---	---	>6.0	---	---	>60	---	Low	High	High.
44B Lihen	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
45*. Dumps and pits												
48B, 48C Moreau	D	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
52 Regan	B/D	Occasional	Brief to long.	Mar-Jun	0-1.0	Apparent	Oct-Jun	>60	---	High	High	Low.
53B, 53C Regent	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	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	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
54B*, 54C*:												
Regent	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
Rhoades	D	None	---	---	>6.0	---	---	>30	Soft	Low	High	Moderate.
55C*:												
Rhoades	D	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Daglum	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
56B Ruso	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
57B Savage	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
59D*:												
Seroco	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Blownout land.												
60, 60B Shambo	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
62B*:												
Daglum Variant	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Moderate.
Daglum	D	None	---	---	>6.0	---	---	30-60	Soft	Moderate	High	Moderate.
63 Straw	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
64 Straw	B	Frequent	Brief	Mar-May	>6.0	---	---	>60	---	Moderate	High	Low.
65B Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
68C*:												
Telfer	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Seroco	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
70B*:												
Beisigl	A	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Lihen	A	None	---	---	>6.0	---	---	>60	---	Low	High	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	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
70B*:												
Flasher----------	D	None--------	---	---	>6.0	---	---	7-20	Soft	Low-------	Moderate	Low.
70D*:												
Beisigl----------	A	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Flasher----------	D	None--------	---	---	>6.0	---	---	7-20	Soft	Low-------	Moderate	Low.
71B--------------- Sen	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Moderate.
80B*:												
Vebar------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Parshall---------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
80C, 83D---------- Vebar	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
84D*:												
Vebar------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Flasher----------	D	None--------	---	---	>6.0	---	---	7-20	Soft	Low-------	Moderate	Low.
90---------------- Velva	B	Occasional	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate	High------	Low.
91F*:												
Schaller---------	A	None--------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Cabba------------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	High------	Low.
101--------------- Brisbane	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; OM, optimum moisture; and NP, nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								LL	PI	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
											Pct		Lb/ft3	Pct
Beisigl loamy fine sand:														
(S81ND037-002)														
Bk------ 12 to 21	A-2-4(0)	SM	100	100	100	100	18	---	4	---	---	NP	116	14
Cr------ 21 to 60	A-2-4(0)	SM	100	100	100	100	12	---	2	---	---	NP	118	13
Breien fine sandy loam:														
(S82ND037-227)														
C2------ 21 to 30	A-2-4(0)	SM	97	95	93	85	20	---	5	---	---	NP	124	11
C3------ 30 to 60	A-2-4(0)	SM	94	93	91	84	14	---	3	---	---	NP	122	12
Brisbane loam:														
(S81ND037-007)														
Bt1----- 6 to 12	A-6-7(11)	CL	100	100	100	99	72	---	32	---	41	21	126	10
2C2----- 40 to 60	A-2-4(0)	SM	99	97	97	96	14	---	4	---	---	NP	113	15
Cabba loam:														
(S82ND037-231)														
Cr1----- 15 to 30	A-4(8)	CL	100	100	100	99	98	---	21	---	29	7	120	13
Cr2----- 30 to 60	A-4(8)	CL	100	100	100	99	99	---	19	---	29	5	120	13
Desart fine sandy loam:														
(S82ND037-244)														
Bt------ 27 to 35	A-4(2)	SM	100	100	100	100	46	---	14	---	---	NP	122	12
C------- 35 to 60	A-2-4(0)	SM	100	100	100	99	28	---	8	---	---	NP	120	12
Ekalaka fine sandy loam:														
(S81ND037-010)														
Bt------ 12 to 17	A-4(1)	CL-ML	100	100	100	100	41	---	17	---	26	6	122	12
C2------ 33 to 60	A-2-6(0)	SC	100	100	100	100	34	---	12	---	36	11	118	13
Flasher loamy fine sand:														
(S82ND037-001)														
Cr1----- 9 to 21	A-2-4(0)	SM	100	100	100	89	24	---	2	---	---	NP	113	15
Cr2----- 21 to 60	A-2-4(0)	SM	100	100	100	80	24	---	2	---	---	NP	111	16
Parshall fine sandy loam:														
(S82ND037-230)														
Bw------ 15 to 25	A-4(1)	ML	100	100	100	99	38	---	10	---	23	3	124	11
BCk----- 31 to 43	A-2-4(0)	ML	100	100	100	99	31	---	10	---	---	NP	124	11
Regent silty clay loam:														
(S81ND037-003)														
Bt1----- 6 to 14	A-7-6(19)	CH	100	100	100	100	94	---	46	---	54	29	122	12
Cr3----- 45 to 60	A-7-6(20)	CH	100	100	100	100	99	---	45	---	72	47	119	13

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Amor	Fine-loamy, mixed Typic Haploborolls
Arnegard	Fine-loamy, mixed Pachic Haploborolls
*Arveson	Coarse-loamy, frigid Typic Calciaquolls
Banks	Sandy, mixed, frigid Typic Ustifluvents
Beisigl	Mixed, frigid Typic Ustipsamments
Belfield	Fine, montmorillonitic Glossic Natriborolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Haploborolls
Brandenburg	Fragmental, mixed, frigid Typic Ustorthents
Breien	Coarse-loamy over sandy or sandy-skeletal, mixed, frigid Mollic Ustifluvents
Brisbane	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Argiborolls
Cabba	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Chama	Fine-silty, mixed Entic Haploborolls
Daglum	Fine, montmorillonitic Typic Natriborolls
Daglum Variant	Fine, montmorillonitic, shallow Typic Natriborolls
Desart	Coarse-loamy, mixed Typic Natriborolls
Ekalaka	Coarse-loamy, mixed Typic Natriborolls
Flasher	Mixed, frigid, shallow Typic Ustipsamments
Grail	Fine, montmorillonitic Pachic Argiborolls
Harriet	Fine, mixed, frigid Typic Natraquolls
Heil	Fine, montmorillonitic, frigid Typic Natraquolls
Lawther	Fine, montmorillonitic Vertic Haploborolls
Lemert	Coarse-loamy, mixed Leptic Natriborolls
Lihen	Sandy, mixed Entic Haploborolls
*Moreau	Fine, montmorillonitic Typic Haploborolls
Parshall	Coarse-loamy, mixed Pachic Haploborolls
*Regan	Fine-silty, frigid Typic Calciaquolls
Regent	Fine, montmorillonitic Typic Argiborolls
Rhoades	Fine, montmorillonitic Leptic Natriborolls
Ruso	Coarse-loamy, mixed Pachic Haploborolls
Savage	Fine, montmorillonitic Typic Argiborolls
Schaller	Sandy, mixed Entic 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
Vebar	Coarse-loamy, mixed Typic Haploborolls
Velva	Coarse-loamy, mixed Fluventic Haploborolls

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