United States
Department of
Agriculture

Natural Resources
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 Griggs County, North Dakota

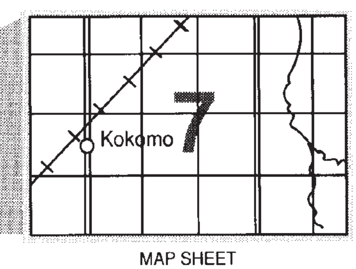
The soil properties and interpretations included in this survey were current as of 1991. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

How to Use This Soil Survey

General Soil Map (STATSGO)

The general soil map immediately preceding the detailed soil maps shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, and then refer to the description of the area.

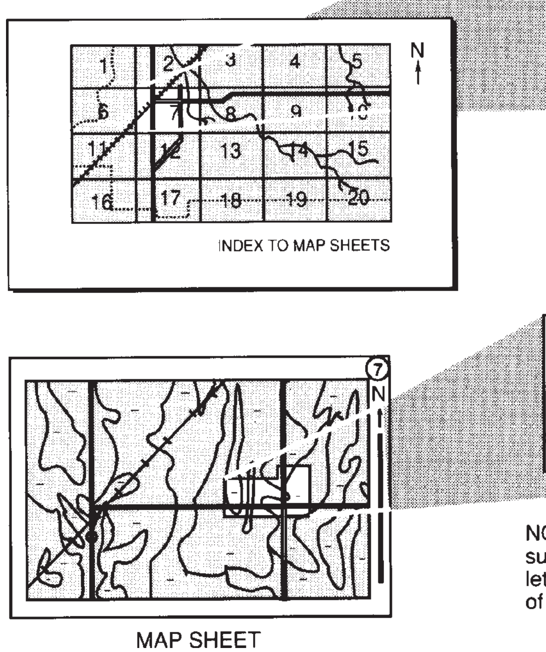


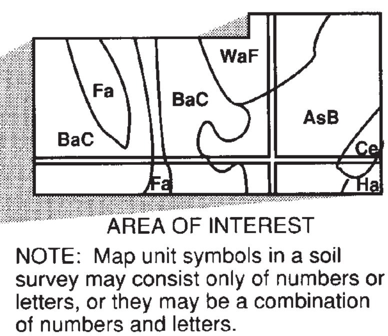
Detailed Soil Maps

The detailed soil maps are found in the packet accompanying the book. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbol that is in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.





The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

For additional information concerning the use of soil surveys refer to North Dakota State University Extension Service Bulletin 60, “Soil Survey: The Foundation for Productive Natural Resource Management,” (Seelig, 1993) and to the USDA-NRCS publication “From the Surface Down: An Introduction to Soil Surveys for Agronomic Use,” (Broderson, 1991).

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 Station, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987 to 1991. This survey was made cooperatively by the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee. It is part of the technical assistance furnished to the Griggs County Soil Conservation District. Financial assistance was provided by the Griggs County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. Maps may not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Sunflowers on an area of Heimdal and Emrick soils. The field shelterbelts help control wind erosion.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on" Technical Resources").

Contents

Issued 2002

Foreword

This soil survey contains information that can be used in land-planning programs in Griggs 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 STATSGO 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 Natural Resources Conservation Service or the Cooperative Extension Service.

Thomas E. Jewett
State Conservationist
Natural Resources Conservation Service

Where to Get Updated Information

The soil properties and interpretations included in this survey were current as of 1991. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

Additional information is available from the Natural Resources Conservation Service Field Office Technical Guide in Cooperstown, North Dakota, or online at www.nrcs.usda.gov/technical/efotg. The data in the Field Office Technical Guide are updated periodically.

Additional information about soils and about NRCS is available through the North Dakota NRCS Web page at www.nd.nrcs.usda.gov.

For further information please contact:

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Cooperstown Field Office
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P.O. Box 526
Cooperstown, North Dakota 58425-0526
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Soil Survey of
Griggs County, North Dakota

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, North Dakota State Soil Conservation Committee, North Dakota State Department of Transportation, and the Griggs County Soil Conservation District.

Map finishing by the North Dakota State Soil Conservation Committee.

General Nature of the Survey Area

GRIGGS COUNTY is in the northeastern part of North Dakota (fig. 1). The county has a total area of 458,400 acres, or 716 square miles. It has 5,200 acres of water in bodies of more than 40 acres in size. The county seat and largest town is Cooperstown.

History

The first recorded settlements in the area were established in the 1880s. Additional information concerning the history and development of Griggs County has been published by the Griggs County Historical Committee (1976).

The first soil survey of a part of Griggs County (approximately 228 square miles) was published in 1906 (Kocher and Hurst, 1906). A general soil map of the county was published in 1968 (Patterson, et al. 1968). The present survey provides additional information and larger scale maps and shows the soils in more detail.

Physiography, Relief, and Drainage

The county is part of the Central Black Glaciated Plains of the Northern Great Plains Spring Wheat Region (USDA-SCS, 1981). Nearly all of Griggs County lies within the Drift Prairie physiographic district of the Central Lowland Province. The county consists mostly of gently undulating areas covered mainly by glacial deposits (Bluemle, 1975).

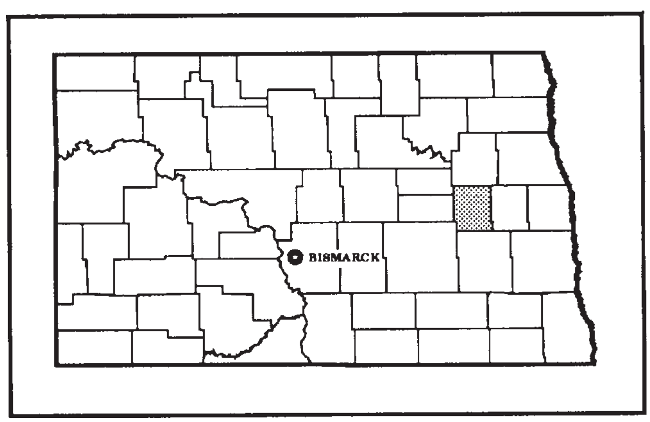

Figure 1. Location of Griggs County in North Dakota.

Elevation in the county ranges from 1,730 feet in the northwestern part to less than 1,450 feet in the southeastern part of the county (Downey and Armstrong, 1977). Local relief rarely exceeds 100 feet/mile. The county is within the Sheyenne-Red River Basin.

Land Uses

Farming and ranching are the main economic enterprises. The principal crops are spring wheat, barley, sunflower, and dry edible beans (Beard and Waldhous, 1997). The Griggs County Soil Conservation District was organized in 1945.

The soils in the county are mostly very deep and well suited to cropland, except the hilly to steep soils which are best suited to rangeland or pastureland. The soil parent material is mostly of glacial origin, with significant glaciolacustrine, till, and glaciofluvial deposits. Many of the soils are susceptible to wind or water erosion. A significant acreage of soils are wet and ponded and produce or have produced habitat for wetland wildlife.

About 86 percent of the area is cropland, and 14 percent is rangeland, hayland, or other land (USDA-SCS, 1992). Irrigation is limited to a small area underlain by aquifers. Additional information related to agriculture in Griggs County can be found in Census of Agriculture (USDA-NASS, 1999). Additional information concerning the ground water resources in Griggs County has been compiled by Downey and Armstrong (1977).

Climate

The climate of Griggs County is subhumid. The area is usually quite warm in summer with frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the area. Most precipitation falls in late spring and early summer.

Table 1, “Temperature and Precipitation,” gives data on temperature and precipitation for the survey area as recorded at Cooperstown, North Dakota, in the period 1961 to 1990. Table 2, “Freeze Dates in Spring and Fall,” shows probable dates of the first freeze in fall and the last freeze in spring. Table 3, “Growing Season,” provides data on length of the growing season.

In January, the average temperature is -4 degrees F, and the average daily minimum temperature is -6 degrees F. In July, the average temperature is 70 degrees F, and the average daily maximum temperature is 84 degrees F.

Growing degree days are shown in Table 1. They are equivalent to “heat units.” During the month, growing degree days accumulate by the amount 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 average annual total precipitation in the county is about 20 inches. Of this, about 15 inches, or 75 percent, usually falls in April through September. The growing season for commonly grown crops falls within this period. Rainfall amounts occurring in 2 years out of 10 are also shown on Table 1. This information is useful in designing a management system for wet and dry years.

Average annual snowfall is 34 inches. The average relative humidity in July is 54 percent. The sun shines 71 percent of the possible time in July and 45 percent of the time in November. The sun shines an average of 59 percent of the possible time annually. The prevailing wind is from the northwest. The average annual windspeed is 11.5 miles per hour (Jensen, 1972).

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and a discussion of the suitability, limitations, and management of the soils and miscellaneous areas for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; 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 to 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 biological activity.

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

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

Soil scientists recorded characteristics of the soil profiles they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils (fig. 2). 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 and to classify soils systematically. Soil Taxonomy (Soil Survey Staff, 1975), 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 soil scientists classified and named the soils in the survey area, they compared individual soils with similar soils in the same taxonomic class in other areas so 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 are collected for laboratory analyses and for engineering tests. Soil scientists interpret data from these analyses and tests as well as field-observed characteristics and soil properties to determine expected behavior of soils under different uses. Interpretations for the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations may be developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict 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,

Figure 2. Profile of Hamerly loam. The dark-colored surface layer surface layer is underlain by a light colored layer that has an accumulation of lime.

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.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

Survey Procedures

The general procedures used to make this survey are described in the National Soil Survey Handbook (Soil Survey Staff,1996b) and the Soil Survey Manual (Soil Survey Staff,1993). The Major Soils of North Dakota (Omodt, et al., 1968), Soil Taxonomy (Soil

Survey Staff, 1975), and Land Resource Regions and Major Land Resource Areas of the United States (USDA-SCS, 1981), were among the references used. The procedures used in determining the nature and characteristics of the soils are described under the heading “How This Survey Was Made.”

All soil mapping was done on field sheets developed from high-altitude black and white aerial photographs from the National High Altitude Photography (NHAP) Program. The scale of the field sheets was 1:24,000 or 2.64 inches to the mile. Detail of these field sheets was checked with older aerial photography, color infrared photography, and in some instances, topographic maps. The soil maps are published on full quadrangle orthophotography.

Soil delineations were drawn on field sheets by traversing the land on foot, by pickup with mounted hydraulic soil probe, or by all-terrain vehicle. Traverses were planned to cross all major landforms and were at intervals close enough to locate contrasting soil areas of about 3 to 5 acres. Soils were examined to a depth of 3 to 5 feet, depending on the kind of soil. Soil properties, including color, texture, structure, horizonation, and presence of salts and stones were examined.

All map units were characterized for soil variability by transecting representative areas. A transect is a series of detailed soil examinations done in a map unit delineation to determine the range of composition of various kinds of soil and soil properties. One transect was required for each 1,000 acres of the unit mapped.

Data collected from the transects were used to determine map unit names and establish the range of composition of soil in each map unit. A statistical method explained by Brubaker and Hallmark (1991) was used for the analyses. This method predicts, at a 90 percent confidence level, the average composition in the county for each named map unit component and similar soil will be between the range given in the map unit description.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Soil pedons were sampled for soil characterization or engineering test data. The soil analyses were made by the Natural Resources Conservation Service’s Soil Survey Laboratory at Lincoln, Nebraska and the North Dakota State Department of Transportation’s Materials and Research Laboratory.

Table 1.—Temperature and Precipitation

(Recorded in the period 1961-90 at Cooperstown, North Dakota.)

Month	Temperature						Precipitation			
	avg daily max	avg daily min	avg	2 years in 10 will have max temp. >than	2 years in 10 will have min temp. <than	avg no. of growing degree days*	avg (in.)	2 yrs in 10 will have less than (in.)	2 yrs in 10 will have more than (in.)	average number of days with 0.10 inch or more
January	16.1	-4.4	5.9	44	-34	0	0.57	0.26	0.91	1
February	22.8	1.8	12.3	48	-31	0	0.41	0.14	0.66	1
March	36.1	15.9	26.0	64	-19	15	0.96	0.51	1.42	3
April	54.6	30.3	42.5	85	6	157	1.65	0.50	2.68	4
May	69.4	42.2	55.8	92	22	495	2.37	1.12	3.45	5
June	78.2	52.1	65.2	94	36	652	3.40	1.73	4.86	6
July	84.0	56.9	70.4	99	42	945	3.13	1.42	4.60	6
August	82.4	54.3	68.4	99	37	876	2.58	1.16	3.80	4
September	70.9	44.0	57.4	94	24	521	2.33	0.74	3.63	4
October	58.1	33.4	45.7	83	13	225	1.21	0.28	1.95	2
November	36.9	17.7	27.3	66	-13	20	0.70	0.21	1.14	2
December	20.9	1.8	11.3	49	-29	0	0.54	0.29	0.79	2
Yearly :										
Average	52.5	28.8	40.7	—	—	—	—	—	—	—
Extreme	104	-36	—	101	-34	—	—	—	—	—
Total	—	—	—	—	—	4,006	19.85	16.67	22.89	40

* 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 (Threshold: 40.0 deg. F)

Table 2.—Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Cooperstown, North Dakota.)

Probability	Temperature		
	24F or lower	28F or lower	32F or lower
Last freezing temperature in spring :			
1 year in 10 later than—	May 11	May 18	May 30
2 year in 10 later than—	May 6	May 14	May 25
5 year in 10 later than—	April 25	May 5	May 15
First freezing temperature in fall :			
1 yr in 10 earlier than—	September 24	September 15	September 7
2 yr in 10 earlier than—	September 30	September 20	September 12
5 yr in 10 earlier than—	October 10	September 30	September 20

Table 3.—Growing Season

(Recorded in the period 1961-90 at Cooperstown, North Dakota.)

Probability	Daily Minimum Temperature		
	# days > 24F	# days > 28F	# days > 32F
9 years in 10	137	124	107
8 years in 10	144	130	113
5 years in 10	157	142	126
2 years in 10	171	155	139
1 year in 10	178	161	146

General Soil Map Units (STATSGO)

The general soil map which precedes the detailed soil maps was derived from STATSGO (State Soil Geographic Data Base). STATSGO (USDA-NRCS, 1994) is a small scale digital general soil map of North Dakota and an accompanying data base. It shows broad areas that have a distinctive pattern of soils, relief, and drainage. These similar areas are delineated into general soil map units or soil associations. Each soil association is a unique natural landscape. Typically, they consist of one or more major soils or components and some minor soils or components. The soils making up an association can occur in another association but in a different pattern. The STATSGO map can be used to compare the suitability of large areas for general land uses. Areas of soils suitable for a practice or use can be identified on the map. Likewise, areas that are not suitable can be identified. Broad interpretive groups can be developed using STATSGO data. STATSGO maps are designed to be used primarily for multi-county and state resource evaluation and planning. Interpretive tables and maps can be prepared for North Dakota, or for smaller areas within the state. STATSGO maps can be used as part of a geographic information system (GIS).

The STATSGO map was compiled by generalizing more detailed soil survey maps. Information on the geology, topography, vegetation, and climate was also considered in the development of this map. The data base contains information on each association's acreage and composition. It also contains soil properties and interpretive data.

Maps were compiled at a scale of 1:250,000 (1 inch=4 miles). The smallest delineations are about 1,500 acres in size. STATSGO maps are prepared nationwide at the same scale and join across county and state boundaries. The maps meet national standards for mapping conventions and scale. 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. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions for STATSGO associations in Griggs County begin on page 18. The composition of the named components in the association description includes soils that are similar in properties and behavioral patterns. Not all minor components are listed.

The North Dakota STATSGO map and data base are maintained by the USDA-NRCS Soils staff in Bismarck, North Dakota. For more information on the use of STATSGO, or on the availability of interpretive tables and maps, contact the state NRCS office.

15—Swenoda-Hecla-Wyndmere Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Swenoda	FSL	0-6	MW	40-45
Hecla	LFS	0-6	MW	15-20
Wyndmere	FSL	0-3	SP	10-15
MINOR COMPONENTS				
Buse	L	9-15	W	5-10
Barnes	L	3-6	W	5-10
Cathay	L	0-3	MW	1-5
Parnell	SICL	0-1	VP	1-5

* LFS,loamy fine sand; FSL,fine sandy loam; L,loam; SICL,silty clay loam
** VP,very poor; SP,somewhat poor; MW,moderately well; W,well

Description

These soil areas are level to undulating. They have occasional gentle rises, knolls, swales, and depressions. The dominant soils are on moderately coarse and coarse textured glacial outwash and deltaic deposits. Glacial till is exposed in some areas. Most areas of this association are used for cultivated crops.

Swenoda soils are on slightly elevated rises. The coarse-textured Hecla soils are on flats and swales. Wyndmere soils are on level and gentle, convex positions. Buse and Barnes soils are on convex side slopes of higher knolls and ridges. They formed in glacial till. Cathay soils are on the gentle, lower slopes or concave footslopes. Parnell soils are in depressions and potholes. The Wyndmere and Buse soils have a prominent "high lime" layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind erosion is the main limitation for agriculture. These soils have limited water holding capacity and may be droughty. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations and hazards for agriculture see Table 6.

28—Binford-Coe-Brantford Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Binford	SL	1-9	SE	25-30
Coe	SL	1-9	E	20-25
Brantford	L	0-6	W	10-15
MINOR COMPONENTS				
Divide	L	0-3	SP	5-10
Kensal	L	0-3	MW	5-10
Colvin	SIL	0-1	P	1-5
Southam	SICL	0-1	VP	1-5

* SL,sandy loam; L,loam;SIL,silt loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; MW,moderately well; W,well; SE,somewhat excessive; E,excessive

Description

These soil areas consist of level to gently rolling topography with knolls, elongated ridges, and occasional depressions. The dominant soils are moderately coarse and medium textured. They formed in shaly glacial outwash. Most areas of this association are used for cultivated crops.

Binford and Brantford soils are on flats, side slopes, and broad convex crests of knolls and ridges. The shallow Coe soils are on crests of knolls and ridges and on shoulder slopes surrounding depressions. Divide soils are on gentle, convex positions and flats adjacent to depressions. Kensal soils are on lower side slopes, swales, and broad flats. Colvin soils are on broad, low flats adjacent to depressions and potholes. Southam soils are in depressions and potholes. The Binford, Brantford, Coe, Divide, and Kensal soils are underlain by layers of sand and gravel. The Divide, Colvin, and Coe soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind erosion is the main limitation for agriculture. These soils have limited water holding capacity and may be droughty. Wind erosion may be a hazard. Some areas may have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

29—Binford-Divide-Marysland Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Binford	SL	0-6	SE	25-30
Divide	L	0-3	SP	25-30
Marysland	L	0-1	P/VP	10-15
MINOR COMPONENTS				
Coe	SL	0-6	E	5-10
Brantford	L	0-6	W	5-10
Southam	SICL	0-1	VP	5-10
Maddock	LFS	1-6	W	0-5

* LFS,loamy fine sand; SL,sandy loam; L,loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; W,well; SE,somewhat excessive; E,excessive

Description

These soil areas are on level to undulating landscapes which have occasional swales and depressions. The dominant soils are medium textured and formed in shaly glaciofluvial deposits. Most areas of this association are used for cultivated crops.

Binford and Brantford soils are on flats and gentle rises. Divide soils are on flats and gentle, convex positions adjacent to depressions. Marysland soils occur on flats and gentle, concave positions in drainageways. Southam soils are in depressions and potholes. Maddock soils are intermingled with areas of the Binford and Brantford soils. The Binford, Brantford, Divide, and Marysland soils are underlain by sand and gravel. The Divide and Marysland soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Many of these soils have limited water holding capacity and may be droughty. Wind erosion may be a hazard on some soils. Some areas may have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

40—Hamerly-Barnes-Tonka Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCEN	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Hamerly	L	0-3	SP	35-40
Barnes	L	1-9	W	30-35
Tonka	SIL	0-1	P	10-15
MINOR COMPONENTS				
Vallers	L	0-1	P	5-10
Parnell	SICL	0-1	VP	5-10
Buse	L	3-6	W	1-5
Binford	SL	0-6	SE	1-5

* SL,sandy loam; L,loam; SIL,silt loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; W,well; SE,somewhat excessive

Description

These soil areas are level to gently rolling. They consist of many low, irregularly shaped knolls with short slopes. Numerous swales, rises, poorly drained depressions, and a few prominent marshes are also present. The dominant soils formed in medium textured glacial till and alluvium. Most areas of this association are used for cultivated crops.

Hamerly soils are on gentle, convex positions adjacent to depressions and on flats. Barnes soils are on the plane and convex side slopes of knolls and ridges. Tonka soils are in shallow depressions. Vallers soils are on broad low flats adjacent to depressions and potholes. Parnell soils are in depressions and potholes. Buse soils are on the convex crests and summits. Binford soils are intermingled with the Barnes soils and are underlain with shaly sand and gravel. The Buse, Hamerly, and Vallers soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

These areas generally have periods of wetness and ponding in the spring and after heavy rainfall. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

43—Svea-Hamerly-Buse Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Svea	L	0-9	MW	30-35
Hamerly	L	0-3	SP	15-20
Buse	L	3-9	W	15-20
MINOR COMPONENTS				
Vallers	L	0-3	P	5-10
Cresbard	L	0-3	MW	5-10
Parnell	SICL	0-1	VP	1-5
Tonka	SIL	0-1	P	1-5

* L,loam; SIL,silt loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; MW,moderately well; W,well

Description

These soil areas are level to gently rolling. They consist of many, irregularly shaped knolls with short slopes. Poorly drained depressions and a few prominent marshes are also present. The dominant soils are on medium textured glacial till (fig. 3). Most areas of this association are used for cultivated crops.

Svea soils are on lower side slopes, footslopes, and flats. Hamerly soils are on gentle convex positions adjacent to depressions and on flats. Buse soils are on the convex crests and summits of knolls and ridges. Vallers soils are on broad, low flats adjacent to depressions and potholes. Cresbard soils are on the gentle, lower slopes or on concave side slopes and footslopes of knolls and ridges. Parnell and Tonka soils are in depressions and potholes. The Buse, Hamerly, and Vallers soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind and water erosion are concerns on some soils. Portions of these areas generally have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

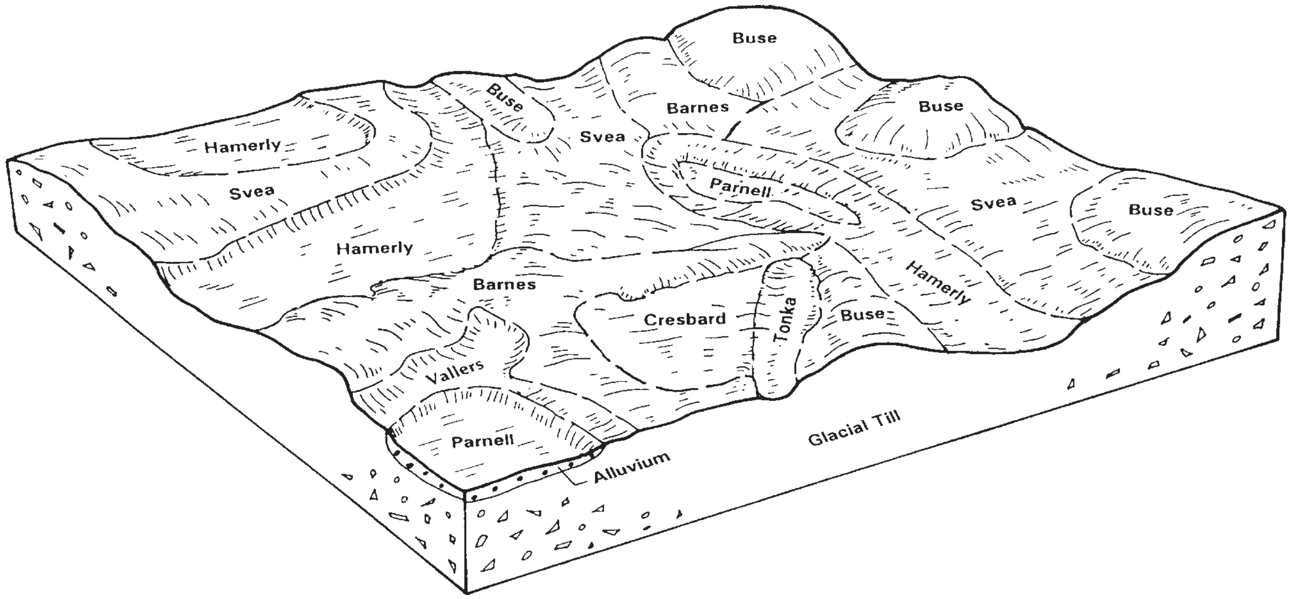

Figure 3. Typical pattern of soils and underlying material in the Svea-Hamerly-Buse association.

46—Barnes-Svea-Hamerly Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Barnes	L	1-9	W	40-45
Svea	L	0-6	MW	20-25
Hamerly	L	0-3	SP	15-20
MINOR COMPONENTS				
Buse	L	3-9	W	5-10
Parnell	SICL	0-1	VP	1-5
Tonka	SIL	0-1	P	1-5
Cavour	L	0-3	MW	1-5

* L,loam; SIL,silt loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; MW,moderately well; W,well

Description

These soil areas consist of level to gently rolling topography with knolls, discontinuous ridges, and depressions. A few prominent marshes are also present. The dominant soils formed in medium textured glacial till. Nearly all the surface runoff drains into depressions (fig. 4). Most areas of this association are used for cultivated crops.

Barnes soils are on the gentle, convex side slopes and broad, convex crests of knolls and ridges. Svea soils are on lower side slopes and flats. Hamerly soils are on gentle, convex positions adjacent to depressions and on flats. Buse soils are on crests and summits of knolls and ridges. Parnell and Tonka soils are in depressions and potholes. Cavour soils are on the gentle, lower slopes intermingled with the Barnes and Svea soils. The Hamerly and Buse soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind and water erosion are concerns on some soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

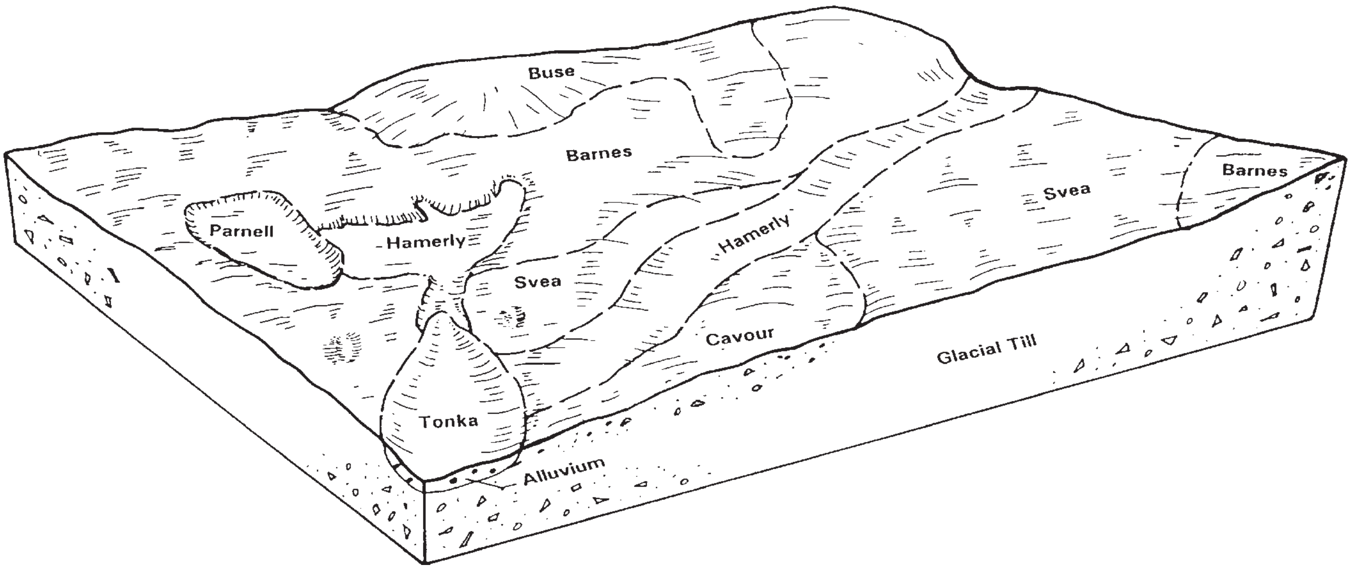

Figure 4. Typical pattern of soils and underlying material in the Barnes-Svea-Hamerly association.

51—Svea-Cresbard-Hamerly Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Svea	L	0-6	MW	40-45
Cresbard	L	0-6	MW	30-35
Hamerly	L	0-3	SP	10-15
MINOR COMPONENTS				
Parnell	SICL	0-1	VP	1-5
Buse	L	3-6	W	1-5
Edgeley	L	3-6	W	1-5
Maddock	LFS	1-6	W	1-5

* LFS, loamy fine sand; L,loam; SICL,silty clay loam
** VP,very poor; SP,somewhat poor; MW,moderately well; W,well

Description

These soil areas are level and undulating. They have many low, irregularly-shaped rises separated by shallow swales and a few depressions. The dominant soils formed in medium textured glacial till. Most areas of this association are used for cultivated crops.

Svea soils are on lower side slopes and flats. Cresbard soils have root restrictive subsoils and are associated with the Svea soils. Hamerly soils are on gentle, convex positions adjacent to depressions and on flats. Parnell soils are in depressions and potholes. Buse soils are on convex crests of knolls and ridges. Edgeley and Maddock soils are intermingled with the Svea soils. The Hamerly and Buse soils have a prominent "high lime" layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

These areas have few limitations for agricultural purposes. Wind erosion is a concern on some soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see "Detailed Map Unit Descriptions" and " Series Descriptions." For information concerning the limitations and hazards for agriculture see Table 6.

55—Emrick-Heimdal-Fram Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Emrick	L	0-6	MW	35-40
Heimdal	L	0-9	W	25-30
Fram	L	0-3	SP	15-20
MINOR COMPONENTS				
Colvin	SIL	0-1	P	5-10
Tonka	SIL	0-1	P	1-5
Cathay	L	0-3	MW	1-5
Stirum	FSL	0-3	P	1-5

* FSL, fine sandy loam; L,loam; SIL,silt loam
** P,poor; SP,somewhat poor; MW,moderately well; W,well

Description

These soil areas are level to gently rolling. They consist of many low, irregularly shaped knolls with short slopes. Numerous swales, rises, ridges, and poorly drained depressions are also present. The dominant soils formed in medium textured glacial till. Most areas of this association are used for cultivated crops.

Emrick soils are on lower side slopes and flats. Heimdal soils are on side slopes of knolls and rises. Fram soils are on gentle, convex positions adjacent to depressions and on flats. Colvin and Tonka soils are in depressions and potholes. Cathay soils are in slightly concave areas associated with the Emrick and Heimdal soils. Stirum soils are on broad flats. The Fram and Colvin soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

These areas have few limitations for agricultural purposes. Wind erosion is a concern on some soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

56—Fram-Heimdal-Emrick Association, level and undulating

	SURFAC EXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Fram	L	0-3	SP	45-50
Heimdal	L	0-6	W	20-25
Emrick	L	0-6	MW	10-15
MINOR COMPONENTS				
Tonka	SIL	0-1	P	1-5
Vallers, saline	L	0-3	P	1-5
Esmond	L	6-15	W	1-5
Binford	FSL	1-6	SE	1-5

* FSL,fine sandy loam; L,loam; SIL,silt loam
** P,poor; SP,somewhat poor; MW,moderately well; W,well; SE,somewhat excessive

Description

These soil areas are level and undulating. They consist of many low, irregularly shaped knolls with short slopes. Numerous swales, rises, and poorly drained depressions are also present. The dominant soils formed in medium textured glacial till. Most areas of this association are used for cultivated crops.

Fram soils are on gentle, convex positions adjacent to depressions and on flats. Heimdal soils are on the plane and convex side slopes of knolls and ridges. Emrick soils are on lower side slopes and flats. Tonka soils are in depressions and potholes. Vallers, saline soils are on broad low flats adjacent to depressions and potholes. Esmond soils are on convex summits and knolls. Binford soils are intermingled with areas of the Heimdal soils and are underlain with shaly sand and gravel. The Esmond, Fram, and Vallers soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

These areas generally have periods of wetness and ponding in the spring and after heavy rainfall. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “ Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

57—Heimdal-Emrick-Esmond Association, level to steep

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Heimdal	L	3-25	W	35-40
Emrick	L	0-6	MW	20-25
Esmond	L	9-35	W	15-20
MINOR COMPONENTS				
Larson	L	0-3	MW	5-10
Parnell	SICL	0-1	VP	5-10
Binford	SL	0-6	SE	1-5
Fram	L	0-3	SP	1-5

* SL,sandy loam; L,loam; SICL,silty clay loam
** VP,very poor; SP,somewhat poor; MW,moderately well; W,well; SE,somewhat excessive

Description

These soil areas are level to steep. They consist of irregularly shaped knolls and ridges with many intermingled areas with gentle slopes and swales. A few prominent depressions are also present. The dominant soils formed in medium textured glacial till (fig. 5). Steep areas are used for range and the rest of the association is mostly used for cultivated crops.

Heimdal soils are on the plane and convex side slopes of knolls and ridges. Emrick soils are on lower side slopes and flats. Esmond soils are on the convex crests and summits of knolls and ridges. Larson soils are on the gentle lower slopes and flats. Parnell soils are in depressions and potholes. Binford soils are intermingled throughout the landscape and are underlain with shaly sand and gravel. Fram soils are on gentle convex positions adjacent to depressions and on flats. The Esmond and Fram soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Water erosion is a concern on these areas. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

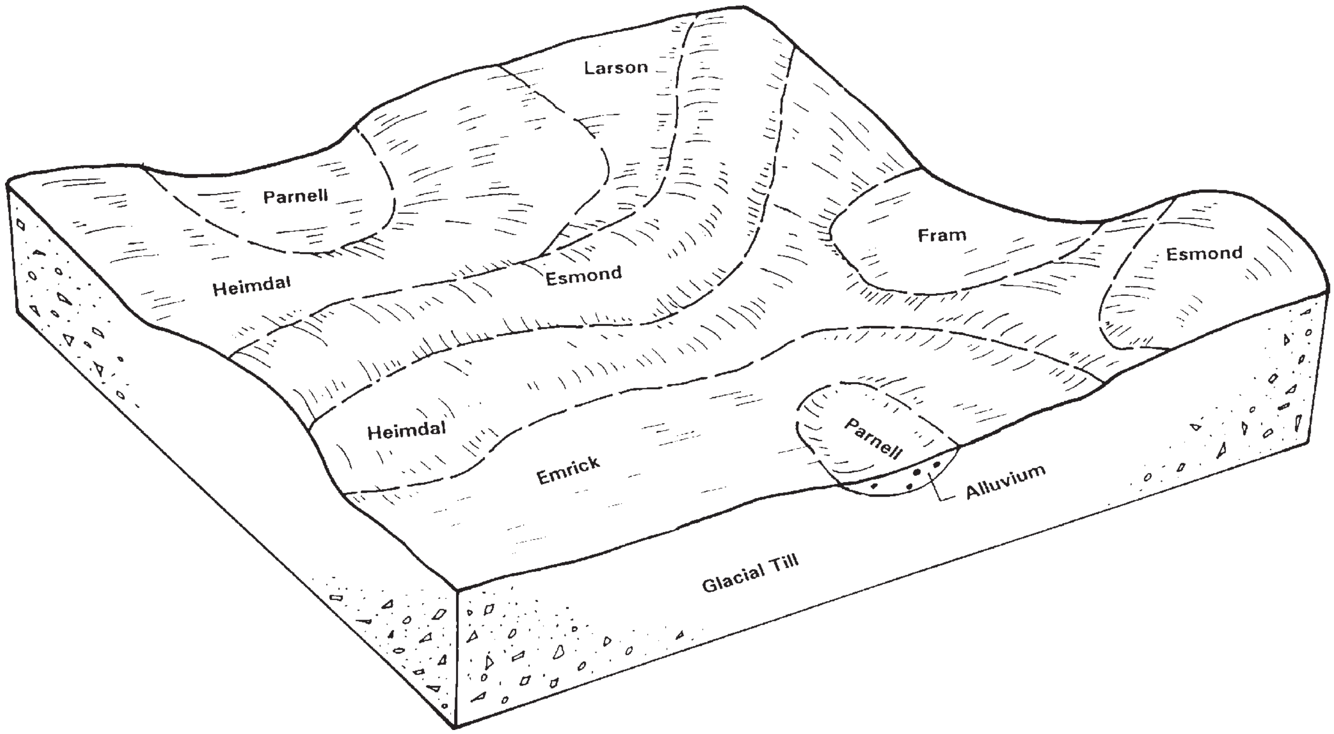

Figure 5. Typical pattern of soils and underlying material in the Heimdal-Emrick-Esmond association.

182—Hamerly-Barnes-Tonka Association, very stony, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Hamerly	L	0-3	SP	45-50
Barnes	L	0-6	W	30-35
Tonka	SIL	0-1	P	10-15
MINOR COMPONENTS				
Swenoda	FSL	0-3	MW	1-5
Vallers	L	0-1	P	1-5
Parnell	SICL	0-1	VP	1-5
Buse	L	15-35	W	1-5

* FSL,fine sandy loam; L,loam; SIL, silt loam; SICL,silty clay loam
** VP,very poor; P,poor; SP,somewhat poor; MW,moderately well; W,well

Description

These level and undulating soil areas are very stony. They consist of many low, irregularly shaped rises, numerous swales, and poorly drained depressions. The dominant soils formed in medium textured glacial till and fine textured alluvium. Most areas of this association are used for rangeland.

Hamerly soils are on gentle convex positions adjacent to depressions and on flats. Barnes soils are on the plane and convex side slopes of rises. Tonka and Parnell soils are in depressions and potholes. Swenoda soils are on flats. Vallers soils are on broad low flats adjacent to depressions and potholes. Buse soils occupy steeper prominent knolls in the area.

Major Limitations for Agricultural Use

These areas are very stony. They also have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see "Detailed Map Unit Descriptions" and " Series Descriptions." For information concerning the limitations and hazards for agriculture see Table 6.

183—LaDelle-Buse-Barnes-Edgeley Association, level to steep

MAJOR COMPONENTS	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
LaDelle	SICL	0-6	MW	30-35
Buse	L	6-35	W	20-25
Barnes	L	3-15	W	15-20
Edgeley	L	9-35	W	10-15
MINOR COMPONENTS				
Sioux	GRL	9-25	E	5-10
Rauville	SIL	0-1	VP	1-5
Nutley	SIC	2-15	W	1-5

* GRL,gravelly loam; L,loam; SIL, silt loam; SICL,silty clay loam; SIC,silty clay
** VP,very poor; MW,moderately well; W,well; E,excessive

Description

These soil areas consist of level valley flood plains and the adjacent steep valley side slopes of the Sheyenne River Valley (fig. 6). The dominant soils are medium textured glacial till, alluvium, and residuum. Most areas of this association are used for rangeland and wildlife habitat.

LaDelle and Rauville soils are on flood plains. Buse and Barnes soils are on the upper valley side slopes. Edgeley soils are intermingled with the Barnes soils on plane side slopes and are underlain by shale bedrock. Sioux soils are on remnant terraces on valley side slopes and are underlain by sand and gravel. Nutley soils are on the lower side slopes.

Major Limitations for Agricultural Use

Water erosion and steep slopes are concerns on these areas. The LaDelle and Rauville soils have potential for flooding. The Edgeley and Sioux soils may be droughty. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see Table 6.

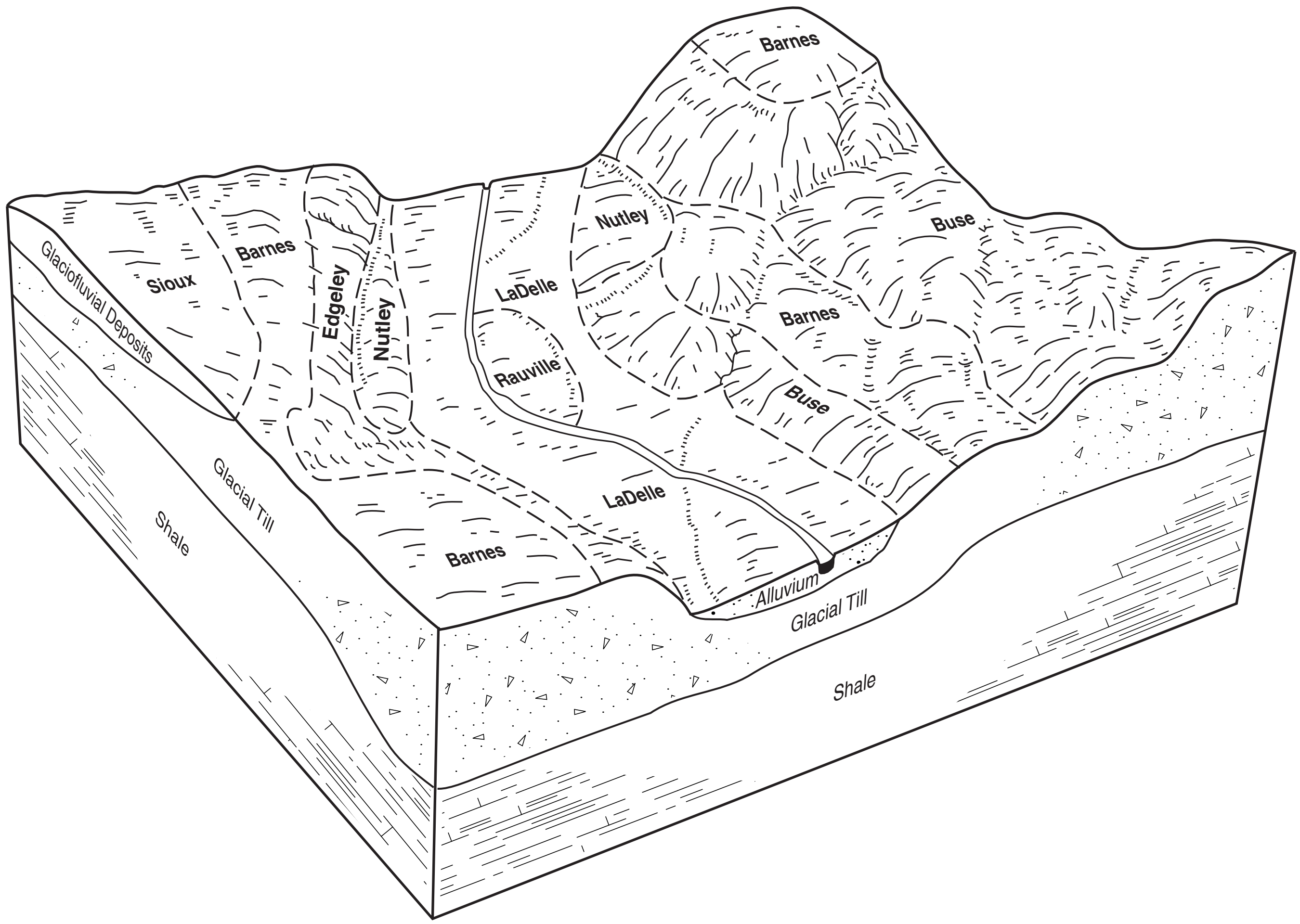

Figure 6. Typical pattern of soils and underlying material in the LaDelle-Buse-Barnes-Edgeley association.

Detailed Soil Map Units

Map units on the detailed soil maps represent soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the soil maps and interpretive tables, 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.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. The soils or miscellaneous areas are called map unit components. The map unit descriptions in this section describe the setting of the map unit or where on the landscape named map unit components can be found. The composition, or the proportion, of various soils or miscellaneous areas of a map unit determine how a map unit is named.

A map unit is identified according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some included areas that belong to other taxonomic classes.

Most included soils have properties 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 similar soils. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting or dissimilar soils. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. Included soils or miscellaneous areas are mentioned in the map unit descriptions. Soil interpretations in this manuscript are for named map unit components only.

A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes 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 if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

The map unit descriptions on the following pages give a range in composition for the named map unit components and similar soils. They also give the average component composition of named, similar, and dissimilar soils.

Soils that have profiles that are almost alike make up a soil series. Except for minor differences in texture of the surface layer or underlying layers, 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 underlying layers. 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, Hecla loamy fine sand, 0 to 3 percent slopes, is one of the phases of the Hecla series.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Hamerly-Tonka complex, 0 to 3 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Bearden and Colvin silt loams, saline, is an undifferentiated group in this survey area.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Pits, gravel and sand, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by special symbols on the soil maps.

The map unit descriptions on the following pages give information on each named component. Information such as surface layer texture, depth class, and drainage class are included. There is also information concerning the management of the map unit.

An identifying symbol precedes the map unit name in each map unit description. This symbol is used to identify delineations on the soil maps.

Table 4, “Acreage and Proportionate Extent of the Soils,” gives the acreage and proportionate extent of each map unit in the survey area. Additional information about each named component and map unit inclusion can be found in “Soil Series and Their Morphology.” Hydric soils information can be found in the section “Hydric Soils.” Table 24 “Hydric Soil List” indicates the map unit components with hydric conditions. Other 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 or miscellaneous areas.

61—Arveson fine sandy loam

Setting

These soils occur on plane or concave slopes on flats and in swales on lake plains.

Map Unit Composition (percent)

Named Components

Arveson and similar soils: 80 to 95

Average Component Composition

Arveson: 63
Tiffany: 18
Arveson, saline: 5
Wyndmere: 5
Hamar, poorly drained: 3
Rosewood, very poorly drained: 3
Manfred: 3

Named Component Description

Arveson

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal

Notes: In places the texture of the Arveson soils below a depth of 40 inches is gravelly sand.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

118—Barnes-Buse loams, 3 to 6 percent slopes

Setting

Barnes soils occur on plane side slopes on rises. Buse soils occur on convex shoulder slopes and summits on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Barnes and similar soils: 45 to 65
- Buse and similar soils: 25 to 50

Average Component Composition
- Barnes: 41
- Buse: 37
- Svea: 15
- Hamerly: 3
- Parnell: 1
- Tonka: 1
- Vallers: 1
- Langhei: 1

Named Component Description

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony and other places have many shale fragments. Some areas have sand and gravel soils on summits. Also included are narrow steep areas adjacent to drainageways and some gently rolling areas.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

120—Barnes-Buse loams, 6 to 9 percent slopes

Setting

Barnes soils occur on plane side slopes on ridges and knolls. Buse soils occur on convex shoulder slopes and summits on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Barnes and similar soils: 45 to 65
- Buse and similar soils: 30 to 50

Average Component Composition,
- Barnes: 37
- Buse: 40
- Svea: 16
- Brantford: 2
- Langhei: 2
- Hamerly: 1
- Parnell: 1
- Tonka: 1

Named Component Description

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony and other places have many shale fragments. Also included are narrow steep areas adjacent to drainageways and some rolling areas.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

156—Barnes-Svea loams, 3 to 6 percent slopes

Setting

Barnes soils occur on convex summits on rises. Svea soils occur on concave footslopes on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

- Barnes and similar soils: 40 to 65
- Svea and similar soils: 20 to 45

Average Component Composition

- Barnes: 53
- Svea: 33
- Buse: 7
- Hamerly: 3
- Tonka: 2
- Parnell: 1
- Wyard: 1

Named Component Description

Barnes

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Svea

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: Seasonal

Notes: Some places are very stony and other places have many shale fragments. Some areas have sand and gravel soils on summits. Also included are narrow steep areas adjacent to drainageways and some gently rolling areas.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

167—Bearden silt loam

Setting

These soils occur on plane slopes on flats on lake plains.

Map Unit Composition (percent)

Named Components

- Bearden and similar soils: 55 to 80

Average Component Composition

- Bearden: 62
- Perella: 15
- Overly: 13
- Bearden, saline: 5
- Colvin: 2
- Wyndmere: 2
- Enloe: 1

Named Component Description

Bearden

- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Notes: In places the texture of the substratum of the Bearden soils is fine sand or sand and gravel.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

296—Brantford loam, 0 to 3 percent slopes

Setting

These soils occur on flats on outwash plains.

Map Unit Composition (percent)

Named Components

Brantford and similar soils: 75 to 90

Average Component Composition

Brantford: 76
Vang: 12
Binford: 5
Coe: 4
Divide: 1
Kensal: 1
Renshaw: 1

Named Component Description

Brantford

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 3 percent
Flooding: None
Water table: None

Notes: In some places the texture of the surface layer of the Brantford soil is gravelly sandy loam. In some places the texture below a depth of 40 inches is loam and a stone line is present. In other areas the surface is stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

314—Buse-Barnes loams, 9 to 15 percent slopes

Setting

Buse soils occur on convex shoulder slopes and summits on ridges and knolls. Barnes soils occur on plane side slopes on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

Buse and similar soils: 40 to 65
Barnes and similar soils: 30 to 50

Average Component Composition

Buse: 51
Barnes: 24
Svea: 17
Hamerly: 4
Coe: 1
Lamoure: 1
Maddock: 1
Tonka: 1

Named Component Description

Buse

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 15 percent
Flooding: None
Water table: None

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 9 to 15 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony and other places have many shale fragments. Some areas adjacent to drainageways are steeper.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

319—Buse-Barnes loams, 15 to 35 percent slopes

Setting

Buse soils occur on convex shoulder slopes and summits on ridges and knolls. Barnes soils occur on plane side slopes on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Buse and similar soils: 40 to 65
- Barnes and similar soils: 30 to 55

Average Component Composition
- Buse: 43
- Barnes: 24
- Svea: 18
- Langhei: 9
- Lamoure: 2
- Vang: 2
- Coe: 1
- Maddock: 1

Named Component Description

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 15 to 35 percent
- Flooding: None
- Water table: None

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 15 to 25 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. Other places may have many shale fragments. Some areas are moderately sloping or strongly sloping.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Rangeland or wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

391—Cavour-Cresbard loams, 0 to 3 percent slopes

Setting

Cavour soils occur on flats. Cresbard soils occur on convex slopes on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Cavour and similar soils: 30 to 55
- Cresbard and similar soils: 25 to 50

Average Component Composition
- Cavour: 36
- Cresbard: 37
- Svea: 11
- Ferney: 7
- Hamerly, saline: 4
- Hamerly: 3
- Edgeley: 1
- Tonka: 1

Named Component Description

Cavour
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal
- Salt affected: Saline within 30 inches
- Sodium affected: Sodic within 30 inches

Cresbard
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal
- Sodium affected: Sodic within 30 inches

Notes: In some places the substratums of these soils do not have redoximorphic features. Some of these soils may have many shale fragments.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

450—Colvin silt loam

Setting

These soils occur on plane slopes on flats on lake plains.

Map Unit Composition (percent)

Named Components
- Colvin and similar soils: 75 to 95

Average Component Composition
- Colvin: 81
- Perella: 7
- Marysland: 3
- Colvin, very poorly drained: 3
- Bearden: 2
- Fram: 2
- Wyndmere: 2

Named Component Description

Colvin
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Notes: In places this soil is very poorly drained and may be saline.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

511—Divide loam, 0 to 3 percent slopes

Setting

These soils occur on flats on outwash plains.

Map Unit Composition (percent)

Named Components
Divide and similar soils: 80 to 95

Average Component Composition
Divide: 74
Wyrene: 14
Marysland: 5
Hamerly: 3
Wyard: 2
Fram: 1
Hamar: 1

Named Component Description
Divide
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Notes: In places the depth to sand and gravel in the Divide soil may be less than 20 inches. In other places the depth to accumulated lime is more than 16 inches. Some areas may be saline.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

536—Eckman-Zell silt loams, 6 to 9 percent slopes

Setting

Eckman soils occur on plane side slopes on ridges and knolls. Zell soils occur on convex shoulder slopes and summits on ridges and knolls. These soils occur on lake plains.

Map Unit Composition (percent)

Named Components
Eckman and similar soils: 40 to 65
Zell and similar soils: 30 to 55

Average Component Composition
Eckman: 29
Zell: 44
Gardena: 18
Overly: 4
Coe: 2
Bearden: 1
Colvin: 1
Maddock: 1

Named Component Description

Eckman
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Zell
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Notes: In places the texture of these soils below a depth of 40 inches is sandy. In other places the slopes are steeper.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

539—Edgeley loam, 0 to 3 percent slopes

Setting

These soils occur on flats on till plains.

Map Unit Composition (percent)

Named Components
- Edgeley and similar soils: 70 to 90

Average Component Composition
- Edgeley: 83
- Walsh: 6
- Barnes: 3
- Cresbard: 3
- Kloten: 2
- Hamerly, saline: 2
- Svea: 1

Named Component Description

Edgeley
- Surface layer texture: Loam
- Depth class: Moderately deep (20 to 40 inches)
- Drainage class: Well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: None

Notes: In places the depth to bedrock in the Edgeley soil is greater than 40 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

541—Edgeley loam, 3 to 6 percent slopes

Setting

These soils occur on convex slopes on rises on till plains.

Map Unit Composition (percent)

Named Components
- Edgeley and similar soils: 80 to 95

Average Component Composition
- Edgeley: 84
- Kloten: 8
- Svea: 2
- Walsh: 2
- Brantford: 2
- Vang: 1
- Cresbard: 1

Named Component Description

Edgeley
- Surface layer texture: Loam
- Depth class: Moderately deep (20 to 40 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Notes: In places the depth to bedrock in the Edgeley soils is greater than 40 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

569—Embden fine sandy loam

Setting

These soils occur on flats on lake plains.

Map Unit Composition (percent)

Named Components
- Embden and similar soils: 75 to 95

Average Component Composition
- Embden: 69
- Embden, gravelly substratum: 15
- Maddock: 5
- Egeland: 4
- Tiffany: 3
- Wyndmere: 2
- Perella: 2

Named Component Description

Embden
- Surface layer texture: Fine sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Notes: In some places the surface texture of the Embden soils is loam. In places the substratum of the Embden soils below a depth of 40 inches is loam, silt loam, or silty clay loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

579—Embden-Egeland fine sandy loams, 1 to 6 percent slopes

Setting

Embden soils occur on flats. Egeland soils occur on convex slopes on rises. These soils occur on lake plains.

Map Unit Composition (percent)

Named Components
- Embden and similar soils: 45 to 70
- Egeland and similar soils: 20 to 45

Average Component Composition
- Embden: 58
- Egeland: 29
- Divide: 4
- Binford: 3
- Zell: 3
- Wyndmere: 1
- Glyndon: 1
- Tiffany: 1

Named Component Description

Embden
- Surface layer texture: Fine sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 1 to 6 percent
- Flooding: None
- Water table: Seasonal

Egeland
- Surface layer texture: Fine sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 1 to 6 percent
- Flooding: None
- Water table: None

Notes: In some places the surface texture of these soils is loam. In places the texture below a depth of 40 inches is loam, silt loam, or silty clay loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

595—Emrick-Cathay loams, 0 to 3 percent slopes

Setting

Emrick soils occur on convex slopes on rises. Cathay soils occur on flats. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

- Emrick and similar soils: 50 to 75
- Cathay and similar soils: 20 to 40

Average Component Composition

- Emrick: 49
- Cathay: 28
- Heimdal: 11
- Larson: 7
- Towner : 2
- Esmond: 1
- Fram: 1
- Tonka: 1

Named Component Description

Emrick

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Cathay

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal
- Sodium affected: Sodic within 30 inches

Notes: Some soils have many shale fragments throughout the profile. In some areas the texture of the Emrick and Cathay soils below a depth of 40 inches is sandy. In other places the substratum does not have redoximorphic features.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

597—Emrick-Heimdal loams, 0 to 3 percent slopes

Setting

Emrick soils occur on flats. Heimdal soils occur on convex slopes on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

- Emrick and similar soils: 35 to 60
- Heimdal and similar soils: 30 to 55

Average Component Composition

- Emrick: 48
- Heimdal: 40
- Fram: 4

Wyard: 3
Esmond: 2
Tonka: 1
Tiffany: 1
Lanona: 1

Named Component Description

Emrick
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Heimdal
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 3 percent
Flooding: None
Water table: None

Notes: In some places the texture of the Emrick and Heimdal soils below a depth of 40 inches is sandy.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

605—Esmond-Heimdal loams, 9 to 15 percent slopes

Setting

Esmond soils occur on convex shoulder slopes and summits on ridges and knolls. Heimdal soils occur on plane side slopes on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
Esmond and similar soils: 35 to 60
Heimdal and similar soils: 30 to 55

Average Component Composition
Esmond: 46
Heimdal: 28
Emrick: 15
Binford: 4
Coe: 4
Maddock: 1
Tonka: 1
Wyard: 1

Named Component Description

Esmond
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 15 percent
Flooding: None
Water table: None

Heimdal
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 15 percent
Flooding: None
Water table: None

Notes: Some places are very stony. In other areas the slopes may be steeper.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

753—Fram-Wyard loams, 0 to 3 percent slopes

Setting

Fram soils occur on flats. Wyard soils occur on concave slopes in swales. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Fram and similar soils: 60 to 80
- Wyard and similar soils: 10 to 30

Average Component Composition
- Fram: 70
- Wyard: 20
- Tonka: 3
- Emrick: 2
- Divide: 2
- Heimdal: 1
- Wyndmere, saline: 1
- Vallers: 1

Named Component Description

Fram
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Wyard
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

769—Gardena silt loam, 0 to 3 percent slopes

Setting

These soils occur on flats on lake plains.

Map Unit Composition (percent)

Named Components
- Gardena and similar soils: 75 to 90

Average Component Composition
- Gardena: 56
- Overly: 25
- Eckman: 11
- Glyndon: 3
- Bearden: 2
- Lindaas: 2
- Zell: 1

Named Component Description

Gardena
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Notes: In places the Gardena soil is saline. In other places the texture of the substratum is fine sand or coarser.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering

Rangeland
Recreation
Soil Properties
Wildlife Habitat

773—Gardena-Eckman silt loams, 3 to 6 percent slopes

Setting

Gardena soils occur on plane or concave side slopes and footslopes on rises. Eckman soils occur on convex summits on rises. These soils occur on lake plains.

Map Unit Composition (percent)

Named Components
Gardena and similar soils: 30 to 55
Eckman and similar soils: 25 to 50
Average Component Composition
Gardena: 35
Eckman: 28
Great Bend: 12
Overly: 9
Bearden: 7
Zell: 7
Colvin: 1
Lankin: 1

Named Component Description

Gardena
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 3 to 6 percent
Flooding: None
Water table: Seasonal
Eckman
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 3 to 6 percent
Flooding: None
Water table: None

Notes: In places the texture of the substratum of these soils is fine sand or coarser.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

881—Hamerly-Tonka complex, 0 to 3 percent slopes

Setting

Hamerly soils occur on flats. Tonka soils occur on concave slopes in depressions. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
Hamerly and similar soils: 40 to 60
Tonka and similar soils: 25 to 50
Average Component Composition
Hamerly: 44
Tonka: 37
Wyard: 9
Vallers: 4
Parnell: 3
Cresbard: 1
Hamerly, saline: 1
Svea: 1

Named Component Description

Hamerly
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Tonka

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Ponding: Very long

Notes: Some areas are undulating. Other areas may be very stony. In some places the substratums are sand and gravel.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

884—Hamerly-Wyard loams, 0 to 3 percent slopes

Setting

Hamerly soils occur on flats. Wyard soils occur on concave slopes in swales. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

Hamerly and similar soils: 40 to 65
Wyard and similar soils: 20 to 45

Average Component Composition

Hamerly: 52
Wyard: 33
Tonka: 7
Vallers: 3
Divide: 2
Barnes: 1
Hamerly, saline: 1
Fram: 1

Named Component Description

Hamerly

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Wyard

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal

Notes: Some areas are undulating.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

893—Harriet silt loam

Setting

These soils occur on plane or concave slopes in drainageways on till plains.

Map Unit Composition (percent)

Named Components

Harriet and similar soils: 85 to 95

Average Component Composition
- Harriet: 52
- Manfred: 21
- Colvin, saline: 15
- Stirum: 5
- Ojata: 4
- Colvin, very poorly drained: 2
- Bearden: 1

Named Component Description

Harriet
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: Occasional
- Water table: Seasonal
- Salt affected: Saline within 30 inches
- Sodium affected: Sodic within 30 inches

Notes: In places the accumulated lime in the Harriet soils is below a depth of 16 inches. Some places are underlain by shale.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

988—Heimdal-Emrick loams, 3 to 6 percent slopes

Setting

Heimdal soils occur on convex summits on rises. Emrick soils occur on concave footslopes on rises. These slopes occur on till plains.

Map Unit Composition (percent)

Named Components
- Heimdal and similar soils: 45 to 70
- Emrick and similar soils: 15 to 40

Average Component Composition
- Heimdal: 58
- Emrick: 28
- Esmond: 7
- Coe: 2
- Fram: 2
- Binford: 1
- Cathay: 1
- Wyard: 1

Named Component Description

Heimdal
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Emrick
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. In other areas the slopes are steeper.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

998—Heimdal-Esmond loams, 6 to 9 percent slopes

Setting

Heimdal soils occur on plane side slopes on ridges and knolls. Esmond soils occur on convex shoulder slopes and summits on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Heimdal and similar soils: 40 to 65
- Esmond and similar soils: 20 to 45

Average Component Composition
- Heimdal: 38
- Esmond: 32
- Emrick: 18
- Maddock: 5
- Binford: 3
- Coe: 2
- Fram: 1
- Vallers: 1

Named Component Description

Heimdal
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Esmond
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. In other areas the slopes are steeper.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1001—Heimdal-Esmond loams, 15 to 35 percent slopes

Setting

Heimdal soils occur on plane side slopes on ridges and knolls. Esmond soils occur on convex shoulder slopes and summits on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Heimdal and similar soils: 40 to 65
- Esmond and similar soils: 25 to 45

Average Component Composition
- Heimdal: 31
- Esmond: 33
- Emrick: 25
- Sioux: 5
- Maddock: 3
- Binford: 1
- Coe: 1
- Dickey: 1

Named Component Description

Heimdal
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 15 to 25 percent
- Flooding: None
- Water table: None

Esmond
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 15 to 35 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. Other areas may be moderately sloping or strongly sloping.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Rangeland or wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1015—Kensal loam

Setting

These soils occur on flats on outwash plains.

Map Unit Composition (percent)

Named Components
- Kensal and similar soils: 80 to 95

Average Component Composition
- Kensal: 79
- Walum: 8
- Overly: 5
- Binford: 4
- Gardena: 2
- Coe: 1
- Divide: 1

Named Component Description

Kensal
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1062—LaDelle silty clay loam, 0 to 3 percent slopes

Setting

These soils occur on flats on flood plains.

Map Unit Composition (percent)

Named Components
- LaDelle and similar soils: 65 to 85

Average Component Composition
- LaDelle: 67
- Wahpeton: 15
- LaPrairie: 7
- Ludden: 4
- Rauville: 4
- Velva: 2
- Lamoure: 1

Named Component Description

LaDelle
- Surface layer texture: Silty clay loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: Occasional
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1108—Larson-Cathay loams, 0 to 3 percent slopes

Setting

Larson soils occur on flats. Cathay soils occur on plane or convex slopes on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
Larson and similar soils: 30 to 55
Cathay and similar soils: 25 to 50
Average Component Composition
Larson: 42
Cathay: 32
Fram: 8
Emrick: 7
Tonka: 4
Ferney: 4
Fram, saline: 2
Esmond: 1

Named Component Description

Larson
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal
Salt affected: Saline within 30 inches
Sodium affected: Sodic within 30 inches
Cathay
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal
Sodium affected: Sodic within 30 inches

Notes: Some places have many shale fragments. In other areas the texture of the Larson and Cathay soils below a depth of 40 inches is sandy. In some areas the substratums do not have redoximorphic features.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1188—Ludden silty clay

Setting

These soils occur on flats on flood plains.

Map Unit Composition (percent)

Named Components
Ludden and similar soils: 80 to 95
Average Component Composition
Ludden: 87
Ludden, saline: 6
LaDelle: 4
Rauville: 2
Lamoure: 1

Named Component Description

Ludden
Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: Occasional
Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to the map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1189—Ludden silty clay, saline

Setting

These soils occur on flats on flood plains.

Map Unit Composition (percent)

Named Components
Ludden and similar soils: 70 to 85
Average Component Composition
Ludden: 64
Ludden, nonsaline: 22
Ryan: 11
LaDelle: 1
Lamoure: 1
Rauville: 1

Named Component Description

Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: Occasional
Water table: Seasonal
Salt affected: Saline within 30 inches

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1221—Maddock-Hecla loamy fine sands, 1 to 6 percent slopes

Setting

Maddock soils occur on plane or convex slopes on rises. Hecla soils occur on flats. These soils occur on outwash plains.

Map Unit Composition (percent)

Named Components
Maddock and similar soils: 50 to 70
Hecla and similar soils: 20 to 40
Average Component Composition
Maddock: 47
Hecla: 25
Serden: 11
Towner: 4
Maddock, fine sandy loam: 4
Coe: 3
Esmond: 3
Dickey: 3

Named Component Description

Maddock
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 1 to 6 percent
Flooding: None
Water table: None
Hecla
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 1 to 3 percent
Flooding: None
Water table: Seasonal

Notes: In places the texture of the Maddock and Hecla soils is coarse sand throughout.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1267—Marysland loam

Setting

These soils occur on flats on outwash plains.

Map Unit Composition (percent)

Named Components

- Marysland and similar soils: 80 to 95

Average Component Composition

- Marysland: 86
- Marysland, saline, very poorly drained: 4
- Colvin: 3
- Vallers: 3
- Divide: 3
- Wyrene: 1

Named Component Description

Marysland

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Notes: In places the accumulated lime in the Marysland soils is below a depth of 16 inches. In other places the depth to sand and gravel is less than 20 inches. Some areas may be stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1268—Marysland loam, wet

Setting

These soils occur on concave slopes in depressions on outwash plains.

Map Unit Composition (percent)

Named Components

- Marysland and similar soils: 85 to 95

Average Component Composition

- Marysland: 61
- Colvin, very poorly drained: 16
- Marysland, poorly drained: 11
- Lamoure: 7
- Southam: 3
- Divide: 1
- Tiffany: 1

Named Component Description

Marysland

- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Very poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Notes: In places the depth to sand and gravel is less than 20 inches. Some areas are saline or stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1427—Parnell silty clay loam

Parnell soils occur on concave slopes in depressions on till plains.

Map Unit Composition (percent)

Named Components
- Parnell and similar soils: 75 to 90

Average Component Composition
- Parnell: 74
- Vallers: 10
- Grano: 7
- Colvin, very poorly drained: 4
- Hamerly: 2
- Tonka: 2
- Southam: 1

Named Component Description

Parnell
- Surface layer texture: Silty clay loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Very poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Ponding: Very long

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1454—Wyndmere fine sandy loam, loamy substratum, 0 to 3 percent slopes

Setting

These soils occur on flats on lake plains.

Map Unit Composition (percent)

Named Components
- Wyndmere and similar soils: 70 to 90

Average Component Composition
- Wyndmere: 62
- Wyrene: 9
- Divide: 8
- Tiffany, somewhat poorly drained: 7
- Embden: 6
- Hamar, poorly drained: 5
- Arveson: 3

Named Component Description

Wyndmere
- Surface layer texture: Fine sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1466—Pits, sand and gravel

Setting

These soils occur on till plains.

Map Unit Composition (percent)

Named Components
Pits, sand and gravel: 90
Average Component Composition
Pits, sand and gravel: 90
Sioux: 4
Water: 3
Arvilla: 3

Named Component Description

Definition: Areas from which soil and gravel have been removed. Some areas have been smoothed and overburden material replaced.

Surface layer texture: Extremely gravelly sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 0 to 60 percent
Flooding: None
Water table: None

For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildife Habitat

1710—Southam silty clay loam

Setting

These soils occur on concave slopes in depressions on till plains.

Map Unit Composition (percent)

Named Components
Southam and similar soils: 80 to 95
Average Component Composition
Southam: 79
Parnell: 11
Vallers: 5
Water: 2
Colvin, very poorly drained: 2
Colvin, saline: 1

Named Component Description

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Ponding: Very long
Salt affected: Saline within 30 inches

Notes: In some places sand and gravel are below a depth of 18 inches in the Southam soils. These areas are usually ponded with 1 to 5 feet of water.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildife Habitat

1762—Svea-Barnes loams, 0 to 3 percent slopes

Setting

Svea soils occur on plane slopes on flats. Barnes soils occur on convex slopes on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Svea and similar soils: 40 to 65
- Barnes and similar soils: 25 to 45

Average Component Composition
- Svea: 52
- Barnes: 33
- Hamerly: 9
- Tonka: 2
- Wyard: 2
- Cresbard: 1
- Vang: 1

Named Component Description

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. Other places have many shale fragments. Some areas have sand and gravel soils on summits. Other areas may be gently undulating. The substratum of the Svea soils does not have redoximorphic features in all areas.

Detailed soil description for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1765—Svea-Buse loams, 3 to 6 percent slopes

Setting

Svea soils occur on concave footslopes on rises. Buse soils occur on convex summits on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Svea and similar soils: 35 to 60
- Buse and similar soils: 25 to 50

Average Component Composition
- Svea: 40
- Buse: 35
- Barnes: 11
- Hamerly: 7
- Tonka: 4
- Brantford: 1
- Parnell: 1
- Swenoda: 1

Named Component Description

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: Seasonal

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. Other places have many shale fragments. Some areas have narrow steep areas adjacent to drainageways. Other areas are gently rolling.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1766—Svea-Buse loams, 6 to 9 percent slopes

Setting

Svea soils occur on concave foot slopes on ridges and knolls. Buse soils occur on convex shoulder slopes and summits on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Svea and similar soils: 30 to 55
- Buse and similar soils: 30 to 55

Average Component Composition
- Svea: 35
- Buse: 42
- Barnes: 12
- Hamerly: 6
- Tonka: 2
- Brantford: 1
- Parnell: 1
- Towner: 1

Named Component Description

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Flooding: None
- Water table: None

Notes: Some places are very stony. Other places have many shale fragments. Some areas have narrow steep areas adjacent to drainageways. Other areas are rolling.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1769—Svea-Cresbard loams, 0 to 3 percent slopes

Setting

Svea soils occur on convex slopes on rises. Cresbard soils occur on flats. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Svea and similar soils: 30 to 55
- Cresbard and similar soils: 30 to 55

Average Component Composition
- Svea: 35
- Cresbard: 38
- Barnes: 10
- Hamerly: 6
- Cavour: 6
- Buse: 2
- Ferney: 2
- Tonka: 1

Named Component Description

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Cresbard

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal
Sodium affected: Sodic within 30 inches

Notes: Some places are underlain by sand and gravel. Some areas have many shale fragments.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1781—Swenoda fine sandy loam, 0 to 3 percent slopes

Setting

These soils occur on flats on till plains.

Map Unit Composition (percent)

Named Components

Swenoda and similar soils: 75 to 90

Average Component Composition

Swenoda: 63
Lanona: 20
Towner: 5
Svea: 5
Fram: 3
Tiffany: 3
Buse: 1

Named Component Description

Swenoda

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Notes: In some places the texture of the subsoil or substratum is sandy.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

1843—Towner loamy fine sand, 0 to 6 percent slopes

Setting

These soils occur on plane or convex slopes on flats and rises on till plains.

Map Unit Composition (percent)

Named Components

Towner and similar soils: 70 to 90

Average Component Composition

Towner: 71
Maddock: 14
Swenoda: 7
Tiffany soils: 3
Barnes: 2
Hamar, poorly drained: 2
Grimstad: 1

Named Component Description

Towner
- Surface layer texture: Loamy fine sand
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 6 percent
- Flooding: None
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1883—Vallers-Parnell complex

Setting

Vallers soils occur on flats. Parnell soils occur on concave slopes in depressions. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Vallers and similar soils: 35 to 60
- Parnell and similar soils: 30 to 55

Average Component Composition
- Vallers: 41
- Parnell: 41
- Hamerly: 5
- Vallers, saline: 4
- Marysland: 3
- Southam: 3
- Perella: 2
- Tonka: 1

Named Component Description

Vallers
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Parnell
- Surface layer texture: Silty clay loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Very poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Ponding: Very long

Notes: In some areas, the Vallers soils are very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1886—Hamerly and Vallers loams, saline, 0 to 3 percent slopes

Setting

Hamerly and Vallers soils occur on flats. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Hamerly and similar soils: 20 to 80
- Vallers and similar soils: 20 to 80

Average Component Composition
- Hamerly: 44
- Vallers: 44
- Tonka: 5
- Parnell: 3
- Wyard: 2
- Cavour: 1
- Ferney: 1

Named Component Description

Hamerly
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal
- Salt affected: Saline within 30 inches

Vallers
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Salt affected: Saline within 30 inches

Notes: Some places are strongly saline. In some places the texture of the substratum of the Vallers and Hamerly soils is sand or gravel. Some areas are undulating.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1970—Walum sandy loam

Setting

These soils occur on flats on outwash plains.

Map Unit Composition (percent)

Named Components
- Walum and similar soils: 75 to 90

Average Component Composition
- Walum: 83
- Wyrene: 8
- Embden: 3
- Coe: 2
- Divide: 2
- Fram: 1
- Vallers: 1

Named Component Description

Walum
- Surface layer texture: Sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

1978—Water

Setting

The soils associated with this map unit occur on till plains. Water occurs in depressions and streams.

Map Unit Composition (percent)

Named Components
- Water: 90 percent

Average Component Composition
- Water: 90
- Colvin, poorly drained: 5
- Southam: 5

Named Component Description

Definition: Areas, including ponds, lakes, streams, and reservoirs, that are covered with water in most years during the period that is warm enough for plants to grow or longer.

Management

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2118—Fram-Tonka complex, 0 to 3 percent slopes

Setting

Fram soils occur on flats. Tonka soils occur on concave slopes in depressions. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Fram and similar soils: 45 to 65
- Tonka and similar soils: 25 to 45

Average Component Composition
- Fram: 48
- Tonka: 34
- Wyard: 8
- Heimdal: 4
- Vallers: 3
- Parnell: 1
- Wyndmere: 1
- Glyndon: 1

Named Component Description

Fram
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 3 percent
- Flooding: None
- Water table: Seasonal

Tonka
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Ponding: Very long

Notes: Some places are very stony or saline. Some areas are undulating. In other places the textures of the substratums of the Fram and Tonka soils are sand and gravel.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2121—Ferney loam, 0 to 3 percent slopes

Setting

These soils occur on flats on till plains.

Map Unit Composition (percent)

Named Components
Ferney and similar soils: 55 to 80
Average Component Composition
Ferney: 58
Hamerly, saline: 18
Cavour: 7
Manfred: 6
Wyard: 6
Cresbard: 4
Marysland, saline: 1

Named Component Description

Ferney
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal
Salt affected: Saline within 30 inches
Sodium affected: Sodic within 30 inches

Notes: In some places the substratum does not have redoximorphic features. Some places have many shale fragments.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2151—Binford-Coe sandy loams, 0 to 6 percent slopes

Setting

Binford and Coe soils occur on plane or convex slopes on flats and rises. These soils occur on outwash plains.

Map Unit Composition (percent)

Named Components
Binford and similar soils: 45 to 70
Coe and similar soils: 20 to 45
Average Component Composition
Binford: 46
Coe: 32
Brantford: 12
Vang: 5
Divide: 2
Kensal: 1
Marysland: 1
Walum: 1

Named Component Description

Binford
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Slope: 0 to 6 percent
Flooding: None
Coe
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 0 to 6 percent
Flooding: None

Notes: In places the substratum of the Binford and Coe soils has less than 20 percent shale. In some places the texture below a depth of 40 inches may be loamy. In some areas the texture of the surface is gravelly sandy loam.

Detailed soil descriptions for each map unit component are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland (fig. 7)

Figure 7. An area of Binford-Coe sandy loams, 0 to 6 percent slopes, used for irrigated crops.

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2152—Coe-Binford complex, 6 to 25 percent slopes

Setting

Coe soils occur on convex shoulder slopes and summits on ridges and knolls. Binford soils occur on plane side slopes on ridges and knolls. These soils occur on outwash plains.

Map Unit Composition (percent)

Named Components

- Coe and similar soils: 35 to 60
- Binford and similar soils: 20 to 40

Average Component Composition

- Coe: 51
- Binford: 26
- Vang: 9
- Heimdal: 5
- Esmond: 4
- Brantford: 3
- Divide: 1
- Fram: 1

Named Component Description

Coe

- Surface layer texture: Gravelly sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Excessively drained
- Slope: 6 to 25 percent
- Flooding: None
- Water table: None

Binford

- Surface layer texture: Sandy loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat excessively drained
- Slope: 6 to 15 percent
- Flooding: None
- Water table: None

Notes: In places the substratum of the Coe and Binford soils has less than 20 percent shale. In some places the texture below a depth of 40 inches may be loam. In places the surface is gravelly sandy loam.

Detailed soil description for all map unit components are included in alphabetical order in the section “Soil

Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2153—Edgeley-Kloten-Esmond complex, 9 to 35 percent slopes

Setting

Edgeley soils occur on plane side slopes on ridges. Kloten soils occur on convex shoulder slopes on ridges. Esmond soils occur on convex summits on ridges. These soils occur in valleys.

Map Unit Composition (percent)

Named Components
Edgeley and similar soils: 45 to 65
Kloten and similar soils: 15 to 35
Esmond and similar soils: 5 to 20
Average Component Composition
Edgeley: 53
Kloten: 23
Esmond: 10
Walsh: 4
Coe: 2
Egeland: 2
Nutley: 2
Lamoure, channeled: 2
Mekinock: 2

Named Component Description

Edgeley
Surface layer texture: Silt loam
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Slope: 9 to 25 percent
Flooding: None
Water table: None
Kloten
Surface layer texture: Silt loam
Depth class: Shallow
Drainage class: Well drained
Slope: 9 to 35 percent
Flooding: None
Water table: None
Esmond
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 35 percent
Flooding: None
Water table: None

Notes: In some places bedrock in the Edgeley soils is between a depth of 40 to 60 inches. Some places are very stony. These soils are subject to slumping and soil creep.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Rangeland or wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2156—Lamoure and Rauville silt loams

Setting

Lamoure and Rauville soils occur on plane or concave slopes in drainageways. These soils occur on flood plains.

Map Unit Composition (percent)

Named Components
Lamoure and similar soils: 20 to 80
Rauville and similar soils: 20 to 80

Average Component Composition
Lamoure: 62
Rauville: 28
Marysland: 3
Velva: 3
Divide: 1
Harriet: 1
Vallers: 1
Fairdale: 1

Named Component Description

Lamoure
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: Frequent
Water table: Seasonal

Rauville
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Slope: 0 to 1 percent
Flooding: Frequent
Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2157—Maddock-Esmond-Embden complex, 6 to 15 percent slopes

Setting

Maddock soils occur on plane or convex side slopes on ridges and knolls. Esmond soils occur on convex shoulder slopes and summits on ridges and knolls. Embden soils occur on concave slopes on ridges and knolls. These soils occur on moraines.

Map Unit Composition (percent)

Named Components
Maddock and similar soils: 45 to 65
Esmond and similar soils: 15 to 40
Embden and similar soils: 5 to 20

Average Component Composition
Maddock: 45
Esmond: 20
Embden: 11
Serden: 9
Heimdal: 7
Hecla: 4
Binford: 2
Coe: 1
Ulen: 1

Named Component Description

Maddock
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 15 percent
Flooding: None
Water table: None

Esmond
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 15 percent
Flooding: None
Water table: None

Embden
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Notes: In places the texture of the surface is fine sandy loam or sandy loam. In other places the texture of the Maddock soils is coarse sand throughout. In places the texture of the Embden soils below a depth of 40 inches is loam, silt loam, or silty clay loam. Some areas have steeper slopes or are very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Rangeland or wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2158—Velva fine sandy loam, 0 to 6 percent slopes

Setting

These soils occur on plane or convex slopes on flats and rises on flood plains.

Map Unit Composition (percent)

Named Components
Velva and similar soils: 70 to 90
Average Component Composition
Velva: 81
Banks: 9
Rauville: 4
Lamoure: 3
Tiffany: 1
LaDelle: 1
Water: 1

Named Component Description

Velva
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 6 percent
Flooding: Occasional
Water table: None

Notes: Some places are somewhat poorly drained.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major Use: Hay, pasture, or range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2159—Walsh silty clay loam, 1 to 6 percent slopes

Setting

These soils occur on concave footslopes in valleys.

Map Unit Composition (percent)

Named Components
Walsh and similar soils: 70 to 90
Average Component Composition
Walsh: 64
Barnes: 16
Sinai: 9
Nutley: 8
Kensal: 1
Binford: 1
Edgeley: 1

Named Component Description

Walsh
Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 1 to 6 percent
Flooding: None
Water table: None

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2196—Bearden and Colvin silt loams, saline

Setting

Bearden and Colvin soils occur on flats. These soils occur on lake plains.

Map Unit Composition (percent)

Named Components
- Bearden and similar soils: 20 to 80
- Colvin and similar soils: 20 to 80

Average Component Composition
- Bearden: 35
- Colvin: 47
- Bearden, nonsaline: 8
- Colvin, nonsaline: 4
- Harriet: 2
- Exline: 2
- Colvin, saline, very poorly drained: 1
- Perella: 1

Named Component Description

Bearden
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Salt affected: Saline within 30 inches

Colvin
- Surface layer texture: Silt loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Flooding: None
- Water table: Seasonal
- Salt affected: Saline within 30 inches

Notes: Some places are strongly saline. In some places the texture of the substratum is sand or gravel. Some areas may be undulating.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

2197—Edgeley-Kloten complex, 6 to 9 percent slopes

Setting

Edgeley soils occur on plane side slopes on ridges and knolls. Kloten soils occur on convex shoulder slopes on ridges and knolls. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
- Edgeley and similar soils: 55 to 80
- Kloten and similar soils: 15 to 35

Average Component Composition
- Edgeley: 61
- Kloten: 22
- Heimdal: 6
- Nutley: 3
- Walsh: 3
- Cavour: 2

Emrick: 2
Darnen: 1

Named Component Description

Edgeley
Surface layer texture: Loam
Depth class: Moderately deep (20 to 40 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None
Kloten
Surface layer texture: Silt loam
Depth class: Shallow
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Notes: In places bedrock in the Edgeley soils is between 40 to 60 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2198—Hamar-Hecla loamy fine sands

Setting

Hamar soils occur on plane slopes in depressions and on flats. Hecla soils occur on flats. These soils occur on outwash plains.

Map Unit Composition (percent)

Named Components
Hamar and similar soils: 60 to 80
Hecla and similar soils: 15 to 35
Average Component Composition
Hamar: 61
Hecla: 20
Ulen: 11
Arveson: 2
Wyndmere: 2
Towner 2
Letcher: 1
Fossum: 1

Named Component Description

Hamar
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Hecla
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal

Notes: In some places the texture of the Hamar and Hecla soils below a depth of 40 inches is gravelly sand.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland

Recreation
Soil Properties
Wildlife Habitat

2199—Hamerly-Barnes-Tonka complex, 0 to 6 percent slopes, very stony

Setting

Hamerly soils occur on flats. Barnes soils occur on convex slopes on rises. Tonka soils occur on concave slopes in depressions. These soils occur on till plains.

Map Unit Composition (percent)

Named Components
Hamerly and similar soils: 40 to 65
Barnes and similar soils: 20 to 45
Tonka and similar soils: 5 to 20
Average Component Composition
Hamerly: 30
Barnes: 22
Tonka: 10
Vallers: 19
Emrick: 11
Parnell: 3
Hamerly, saline: 2
Cresbard: 2
Cavour: 1

Named Component Description

Hamerly
Surface layer texture: Stony loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal
Barnes
Surface layer texture: Very stony loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 6 percent
Flooding: None
Water table: None
Tonka
Surface layer texture: Very stony silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Ponding: Very long

Notes: Some places are extremely stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Rangeland or wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:
Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2200—Letcher-Swenoda fine sandy loams, 0 to 3 percent slopes

Setting

Letcher soils occur on flats. Swenoda soils occur on plane side slopes on rises. These slopes occur on till plains.

Map Unit Composition (percent)

Named Components
Letcher and similar soils: 35 to 60
Swenoda and similar soils: 30 to 55
Average Component Composition
Letcher: 43
Swenoda: 24
Lanona: 16
Cathay: 5
Lemert: 4
Stirum: 3
Wyndmere: 3
Towner: 2

Named Component Description

Letcher
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Sodium affected: Sodic within 30 inches

Swenoda

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Flooding: None
Water table: Seasonal

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2201—Stirum-Arveson, saline, fine sandy loams

Setting

Stirum and Arveson soils occur on flats. These soils occur on lake plains.

Map Unit Composition (percent)

Named Components

Stirum and similar soils: 35 to 60
Arveson and similar soils: 25 to 50

Average Component Composition

Stirum: 40
Arveson: 28
Marysland, saline: 9
Manfred: 6
Hamar, poorly drained: 6
Gilby, saline: 5
Letcher: 3
Marysland: 3

Named Component Description

Stirum

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Salt affected: Saline within 30 inches
Sodium affected: Sodic within 30 inches

Arveson

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Flooding: None
Water table: Seasonal
Salt affected: Saline within 30 inches

Notes: Some areas are somewhat poorly drained.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2202—Swenoda-Barnes fine sandy loams, 3 to 6 percent slopes

Setting

Swenoda soils occur on concave footslopes on rises. Barnes soils occur on convex summits on rises. These soils occur on till plains.

Map Unit Composition (percent)

Named Components

Swenoda and similar soils: 35 to 60
Barnes and similar soils: 20 to 45

Average Component Composition

Swenoda: 43
Barnes: 33
Gardena: 9
Buse: 6
Binford: 3
Towner: 3
Maddock: 2
Tonka: 1

Named Component Description

Swenoda

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 3 to 6 percent
Flooding: None
Water table: Seasonal

Barnes

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 3 to 6 percent
Flooding: None
Water table: None

Notes: Some places are very stony. Other places have many shale fragments. Some areas adjacent to drainageways are steeper. Other areas are gently rolling.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2203—Swenoda-Barnes fine sandy loams, 6 to 9 percent slopes

Setting

Swenoda soils occur on concave footslopes. Barnes soils occur on convex shoulder slopes and summits. These soils occur on knobs on till plains.

Map Unit Composition (percent)

Named Components

Swenoda and similar soils: 35 to 60
Barnes and similar soils: 25 to 50

Average Component Composition

Swenoda: 47
Barnes: 36
Buse: 11
Maddock: 2
Coe: 1
Towner: 1
Binford: 1
Vallers: 1

Named Component Description

Swenoda

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Barnes

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Notes: Some places are very stony. Other places have many shale fragments. Some areas adjacent to drainageways are steeper. Some areas are rolling.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2204—Walsh silty clay loam, 6 to 9 percent slopes

Setting

These soils occur on concave foot slopes in valleys.

Map Unit Composition (percent)

Named Components
Walsh and similar soils: 70 to 90
Average Component Composition
Walsh: 56
Sinai: 18
Barnes: 11
Nutley: 7
Edgeley: 5
Wahpeton: 2
Vang: 1

Named Component Description

Walsh
Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 6 to 9 percent
Flooding: None
Water table: None

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

Agronomy
Engineering
Rangeland
Recreation
Soil Properties
Wildlife Habitat

2205—Zell-Eckman silt loams, 9 to 25 percent slopes

Setting

Zell soils occur on convex shoulder slopes and summits. Eckman soils occur on plane side slopes. These soils occur on ridges and knolls on lake plains.

Map Unit Composition (percent)

Named Components
Zell and similar soils: 50 to 75
Eckman and similar soils: 25 to 45
Average Component Composition
Zell: 60
Eckman: 20
Gardena: 9
Emrick: 4
Maddock: 3
Great Bend: 2
Coe: 1
Esmond: 1

Named Component Description

Zell
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 25 percent
Flooding: None
Water table: None

Eckman
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 15 percent
Flooding: None
Water table: None

Notes: Some places have steeper slopes.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section “Soil

Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major Use: Hay, pasture, or range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Rangeland
- Recreation
- Soil Properties
- Wildlife Habitat

Table 4.—Acreage and Proportionate Extent of the Soils

Map Symbol	Soil name	Acres	Percent
61	Arveson fine sandy loam	1,395	0.3
118	Barnes-Buse loams, 3 to 6 percent slopes	9,750	2.1
120	Barnes-Buse loams, 6 to 9 percent slopes	3,460	0.8
156	Barnes-Svea loams, 3 to 6 percent slopes	20,025	4.4
167	Bearden silt loam	6,645	1.4
296	Brantford loam, 0 to 3 percent slopes	4,895	1.1
314	Buse-Barnes loams, 9 to 15 percent slopes	2,140	0.5
319	Buse-Barnes loams, 15 to 35 percent slopes	5,175	1.1
391	Cavour-Cresbard loams, 0 to 3 percent slopes	4,250	0.9
450	Colvin silt loam	4,225	0.9
511	Divide loam, 0 to 3 percent slopes	20,110	4.4
536	Eckman-Zell silt loams, 6 to 9 percent slopes	1,300	0.3
539	Edgeley loam, 0 to 3 percent slopes	1,345	0.3
541	Edgeley loam, 3 to 6 percent slopes	1,305	0.3
569	Embden fine sandy loam	930	0.2
579	Embden-Egeland fine sandy loams, 1 to 6 percent slopes	2,025	0.4
595	Emrick-Cathay loams, 0 to 3 percent slopes	3,085	0.7
597	Emrick-Heimdal loams, 0 to 3 percent slopes	5,930	1.3
605	Esmond-Heimdal loams, 9 to 15 percent slopes	8,965	2.0
753	Fram-Wyard loams, 0 to 3 percent slopes	9,950	2.2
769	Gardena silt loam, 0 to 3 percent slopes	1,390	0.3
773	Gardena-Eckman silt loams, 3 to 6 percent slopes	2,790	0.6
881	Hamerly-Tonka complex, 0 to 3 percent slopes	23,265	5.1
884	Hamerly-Wyard loams, 0 to 3 percent slopes	49,315	10.8
893	Harriet silt loam	1,375	0.3
988	Heimdal-Emrick loams, 3 to 6 percent slopes	27,520	6.0
998	Heimdal-Esmond loams, 6 to 9 percent slopes	11,395	2.5
1001	Heimdal-Esmond loams, 15 to 35 percent slopes	6,785	1.5
1015	Kensal loam	2,215	0.5
1062	LaDelle silty clay loam, 0 to 3 percent slopes	8,465	1.8
1108	Larson-Cathay loams, 0 to 3 percent slopes	1,460	0.3
1188	Ludden silty clay	720	0.2
1189	Ludden silty clay, saline	285	*
1221	Maddock-Hecla loamy fine sands, 1 to 6 percent slopes	6,890	1.5
1267	Marysland loam	4,140	0.9
1268	Marysland loam, wet	1,745	0.4
1427	Parnell silty clay loam	3,890	0.8
1454	Wyndmere fine sandy loam, loamy substratum, 0 to 3 percent slopes	2,270	0.5
1466	Pits, sand and gravel	425	*
1710	Southam silty clay loam	9,135	2.0
1762	Svea-Barnes loams, 0 to 3 percent slopes	13,430	2.9
1765	Svea-Buse loams, 3 to 6 percent slopes	4,360	1.0
1766	Svea-Buse loams, 6 to 9 percent slopes	1,265	0.3
1769	Svea-Cresbard loams, 0 to 3 percent slopes	6,730	1.5
1781	Swenoda fine sandy loam, 0 to 3 percent slopes	10,860	2.4
1843	Towner loamy fine sand, 0 to 6 percent slopes	5,095	1.1
1883	Vallers-Parnell complex	9,020	2.0
1886	Hamerly and Vallers loams, saline, 0 to 3 percent slopes	11,890	2.6
1970	Walum sandy loam	8,130	1.8
1978	Water	3,300	0.7
2118	Fram-Tonka complex, 0 to 3 percent slopes	3,235	0.7
2121	Ferney loam, 0 to 3 percent slopes	4,685	1.0
2151	Binford-Coe sandy loams, 0 to 6 percent slopes	31,730	6.9
2152	Coe-Binford complex, 6 to 25 percent slopes	10,150	2.2
2153	Edgeley-Kloten-Esmond complex, 9 to 35 percent slopes	11,320	2.5
2156	Lamoure and Rauville silt loams	4,205	0.9
2157	Maddock-Esmond-Embden complex, 6 to 15 percent slopes	2,380	0.5
2158	Velva fine sandy loam, 0 to 6 percent slopes	1,055	0.2
2159	Walsh silty clay loam, 1 to 6 percent slopes	3,850	0.8
2196	Bearden and Colvin silt loams, saline	4,170	0.9
2197	Edgeley-Kloten complex, 6 to 9 percent slopes	555	0.1

Table 4.—Acreage and Proportionate Extent of the Soils--(continued)

Map Symbol	Soil name	Acres	Percent
2198	Hamar-Hecla loamy fine sands	1,845	0.4
2199	Hamerly-Barnes-Tonka complex, 0 to 6 percent slopes, very stony	8,460	1.8
2200	Letcher-Swenoda fine sandy loams, 0 to 3 percent slopes	460	0.1
2201	Stirum-Arveson, saline, fine sandy loams	2,660	0.6
2202	Swenoda-Barnes fine sandy loams, 3 to 6 percent slopes	7,845	1.7
2203	Swenoda-Barnes fine sandy loams, 6 to 9 percent slopes	1,405	0.3
2204	Walsh silty clay loam, 6 to 9 percent slopes	1,100	0.2
2205	Zell-Eckman silt loams, 9 to 25 percent slopes	830	0.2
	Total	458,400	100.0

*less than 0.1 percent

Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Formation of the Soils

Soil forms through processes acting on deposited or accumulated geologic material. Characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time that forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of geological deposits and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Finally, time is needed for changing the parent material into soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogical composition of the soil. The soils of Griggs County formed in glacial drift. The advancing glacier picked up rocks and soil, ground and mixed them, and deposited the material as the glacier receded. Some soils, such as Barnes and Svea, formed in unsorted material, or glacial till. Some soils such as Overly and Bearden formed in glaciolacustrine deposits, or glacial material deposited by water in glacial lakes. Other soils, such as Binford and Coe, formed in glaciofluvial deposits, or material deposited by glacial meltwater.

Although the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited.

Geologically, Griggs County is located at the eastern edge of the Williston Basin, and is underlain by Paleozoic and Mesozoic rocks that dip gently to the west. The Cretaceous aged Greenhorn, Carlile, Niobrara, and Pierre Formations lie directly beneath the Glacial Drift. The Pierre Formation is exposed in several places along the Sheyenne River. It consists of medium gray, massive to fissile, noncalcareous shale and siltstone. Pierre Formation is highly weathered in most exposures (Bluemle, 1975). A few soils, such as Edgley and Kloten, did not form from glacial drift. These soils formed in material weathered from the Pierre Formation.

Several processes have been involved in the formation of soils in Griggs County. These processes are accumulation of organic matter; solution, transfer, and removal of calcium carbonates and bases; and liberation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in horizon differentiation.

The parent materials in which most of the soils developed initially contained generous amounts of calcium and magnesium carbonate minerals. These minerals have been dissolved by water and removed from the upper horizons of the soil profile. Pure water is not an effective agent for dissolving calcium and magnesium carbonates. These minerals are only slightly soluble in pure water, but become moderately soluble and dissolve much more rapidly in a weak acid. The respiratory activity of plants is a significant factor in dissolving calcium and magnesium carbonates. As plants respire, they give off carbon dioxide. Carbon dioxide dissolves in water to form a weak carbonic acid solution. This facilitates dissolving calcium and magnesium carbonates in the soil.

In a dissolved state, calcium and magnesium are in the form of ions that have a positive net electrical charge. Calcium and magnesium ions are essential elements in plant nutrition, and can either be taken up by plant roots or carried away (leached) with moving soil water. Some of the calcium and magnesium ions are leached from the soil profiles. “Seep” sites along steep slopes that have deposits of recently precipitated calcium and magnesium carbonates provide evidence of leaching.

A large number of the calcium and magnesium ions that dissolved from carbonate mineral ions are translocated to upper soil horizons by a cyclical process of root uptake and ultimate release when plant material decomposes. As vegetation decays, positively charged calcium and magnesium ions move downward with water to the upper horizons of soil profiles. There they are held by the electrostatic forces of negatively charged clay particles and are again available for plant uptake.

Climate

Climate has direct and indirect effects on the formation of soils. Precipitation, temperature, and wind directly affect the weathering and reworking of soil material. The climate indirectly affects soil formation through its effects on the amount and kind of vegetation and animal life on or in the soil.

In addition to weathering soil material, precipitation and temperature affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Freezing and thawing help break down soil particles in the parent material, thereby providing more surface area for chemical processes. Cool temperatures affect the content of organic matter by slowing the decay of plant material and animal remains.

Griggs County has a continental, subhumid climate characterized by long, cold winters and short, warm summers. The soil is generally frozen to a depth of 3 to 6 feet from November to April. During this time, except for some effects of frost action, the soil forming processes are mostly dormant. Most of the precipitation falls during the growing season and is distributed in an erratic pattern. It is during this part of the year that soil forming processes influenced by climate are most active. The climate is fairly uniform throughout the county.

Living Organisms

Soils in Griggs County formed mainly under grassland vegetation. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. Fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result of these changes in the soil, less water runs off the surface and more moisture is available for increased microbiological activity. Decay of plants improves the available water capacity, tilth, and fertility of the soil. Decayed organic matter, accumulating over long periods, gives the surface layer its dark color.

On somewhat poorly drained and moderately well drained, nearly level soils, such as Bearden, Embden, Hamerly, and Svea, the native vegetation is mainly tall and medium-sized grasses. Principal grasses are big bluestem, switchgrass, indiangrass, and little bluestem.

On well drained and excessively drained, nearly level to steep soils, such as Buse and Coe, short and medium-sized grasses are dominant. Among these grasses are green needlegrass, western wheatgrass, little bluestem, sideoats grama, plains muhly, and blue grama.

On the poorly drained and very poorly drained, depressional soils such as Colvin, Parnell, and Tonka, the vegetation consists of tall grasses, reeds, rivergrass, slough sedge, American mannagrass, northern reedgrass, and prairie cordgrass.

Micro-organisms have important effects on soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients for growth. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help mix the humus with the soil.

Human activities greatly affect soil formation. Management measures can alter soil drainage. They can help to control erosion, thus maintaining fertility. Poor management can increase the susceptibility to erosion and thus result in an unproductive soil.

Topography

Most of Griggs County is level to undulating, but some areas are rolling to steep. Many poorly drained and very poorly drained soils in depressions receive runoff from higher elevations. The steepest areas are end moraines and breaks around rivers and drainageways. Local differences in relief within a square mile range from less than 10 feet to 100 feet.

Relief influences the formation of soil through its effect on drainage, runoff, and erosion. Many differences in the soils of this county result from their topographic position. Among these differences are drainage, thickness of the A horizon, content of organic matter, color, features of the subsoil, thickness of the solum, and degree of horizon differentiation.

Runoff is rapid on steep slopes, and only a small percentage of the rainfall penetrates the soil. Under these conditions, there is little moisture for plant growth and soil development. The soils on steeper slopes are thin and low in organic matter content. They have weak horizonation. Examples are the Buse and Zell soils.

Soils on nearly level to rolling slopes are moderately well drained and well drained. Moisture is sufficient to support good stands of mixed native grasses, and the soils have well developed profiles characterized by a black to very dark gray A horizon and a brown to very dark brown B horizon. Examples are the Barnes and Heimdal soils. Most of the moderately well drained soils occur on level or slightly concave areas. They generally have a thicker A horizon, a darker colored B horizon, and a greater depth to lime than those on convex, undulating, or rolling landscapes. Examples are the Swenoda and Svea soils.

Depressional areas that receive large amounts of runoff from higher elevations have somewhat poor to very poor natural drainage. Soils formed in depressions vary widely in profile development, depending on the degree of wetness. Parnell and Tonka soils, which are in shallow depressions, exhibit an advanced degree of horizonation because of alternate wet and dry cycles that occur in these depressions. These soils have properties much like soils from areas of much higher precipitation. They are examples of soils in which translocated clays have accumulated in the Bt horizon. Gleying, or the reduction and transfer of iron, has occurred to some degree in all of the very poorly to somewhat poorly drained soils in the county. In these naturally wet soils, this process has had a significant influence on horizon differentiation. The gray color and redoximorphic features of the subsoil indicate the redistribution of reduced iron oxides. Southam soils, which are in deep depressions, are nearly continuously wet and have a thick surface layer and carbonates throughout. Horizonation in these soils is minimal and mostly the result of sedimentary rather than soil-forming processes.

Most of the surface in Griggs County is covered with Wisconsin-aged glacial drift. The glacial drift is comprised of glaciofluvial deposits, glaciolacustrine deposits, and glacial till. There are countless small and large potholes in the glacial plain in Griggs County that do not have an outlet to any established drainage channel. During years of high snowfall and rain, water is trapped in these depressions.

Large areas of Griggs County were influenced by water running from the glacier that resulted in the deposition of sand and gravel that is of poor quality for construction purposes. Soils in this area include Binford and Coe. Several gravel pits are found in this area and sand and gravel are being mined. These materials are used mainly for surfacing secondary roads and as a base for paved highways. On-site investigation is needed because the quality of the deposits varies. Excess silt or clay and a high shale content are common limitations for the use of these deposits.

After the glaciers receded, streams carved valleys into the till plain. The Sheyenne River is a glacial meltwater developed valley. It was formed when Glacial Lake Souris, which had developed in the North Central part of the state, drained into Glacial Lake Agassiz at the end of the Pleistocene period. The Sheyenne River formed an extensive terrace system about 50 to 70 feet above the present flood plain.

Time

The formation of 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. Approximately 12,000 years have passed since the glacier receded from Griggs County (Bluemle, 1975). In geological terms, the soils in the county are young.

More time has been available for the formation of Barnes soils on glacial till plains than for the formation of Lamoure soils on flood plains. The forces of soil formation have been continually acting on the parent material of the Barnes soils; however, Lamoure soils are continually gaining new parent material at the surface as a result of flooding. Barnes soils have well defined horizons whereas Lamoure soils have less distinct horizons.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1975, 1996a). 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 5, “Classification of the Soils” shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Haploboroll (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a frigid 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 *Udic* identifies the subgroup that has a udic moisture regime. An example is Udic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, 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 Superactive Udic 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. An example is the Barnes series.

Table 5.—Classification of the Soils

Soil name	Family or higher taxonomic class
Arveson	Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls
Banks*	Sandy, mixed, frigid Typic Ustifluvents
Barnes	Fine-loamy, mixed, superactive Udic Haploborolls
Bearden	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Binford	Sandy, mixed Udic Haploborolls
Brantford	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls
Buse	Fine-loamy, mixed, superactive Udic Calciborolls
Cathay	Fine-loamy, mixed, superactive Glossic Udic Natriborolls
Cavour	Fine, smectitic Udic Natriborolls
Coe	Sandy-skeletal, mixed Udorthentic Haploborolls
Colvin	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Cresbard	Fine, smectitic Glossic Udic Natriborolls
Darnen*	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Dickey*	Sandy over loamy, mixed, superactive Udorthentic Haploborolls
Divide	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls
Eckman	Coarse-silty, mixed, superactive Udic Haploborolls
Edgeley	Fine-loamy, mixed, superactive Udic Haploborolls
Egeland	Coarse-loamy, mixed, superactive Udic Haploborolls
Embden	Coarse-loamy, mixed, superactive Pachic Udic Haploborolls
Emrick	Coarse-loamy, mixed, superactive Pachic Udic Haploborolls
Enloe*	Fine, smectitic, frigid Argiaquic Argialbolls
Esmond	Coarse-loamy, mixed, superactive Udic Calciborolls
Fairdale*	Fine-loamy, mixed, superactive, calcareous, frigid Mollic Udifluvents
Ferney	Fine, smectitic Leptic Natriborolls
Fossum	Sandy, mixed, calcareous, frigid Typic Endoaquolls
Fram	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Gardena	Coarse-silty, mixed, superactive Pachic Udic Haploborolls
Gilby*	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Great Bend*	Fine-silty, mixed, superactive Udic Haploborolls
Grimstad*	Sandy over loamy, mixed, superactive, frigid Aeric Calciaquolls
Hamar	Sandy, mixed, frigid Typic Endoaquolls
Hamerly	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Harriet	Fine, smectitic, frigid Typic Natraquolls
Hecla	Sandy, mixed Aquic Haploborolls
Heimdal	Coarse-loamy, mixed, superactive Udic Haploborolls
Kensal	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Aquic Haploborolls
Kloten	Loamy, mixed, superactive, shallow Udorthentic Haploborolls
LaDelle	Fine-silty, mixed, superactive Cumulic Udic Haploborolls
Lamoure	Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls
Lankin*	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Larson	Fine-loamy, mixed, superactive Udic Natriborolls
Lemert*	Coarse-loamy, mixed, superactive Leptic Natriborolls
Letcher	Coarse-loamy, mixed, superactive Udic Natriborolls
Lindaas*	Fine, smectitic, frigid Typic Argiaquolls
Ludden	Fine, smectitic, frigid Typic Endoaquerts
Maddock	Sandy, mixed Udorthentic Haploborolls
Manfred *	Fine-loamy, mixed, superactive, frigid Typic Natraquolls
Marysland	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls
Mekinock*	Fine, smectitic Leptic Natriborolls
Nutley*	Fine, smectitic, frigid Chromic Hapluderts
Ojata*	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Overly*	Fine-silty, mixed, superactive Pachic Udic Haploborolls

Table 5.—Classification of the Soils--(continued)

Soil name	Family or higher taxonomic class
Parnell	Fine, smectitic, frigid Vertic Argiaquolls
Rauville	Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls
Rosewood*	Sandy, mixed, frigid Typic Calciaquolls
Ryan*	Fine, smectitic, frigid Typic Natraquerts
Serden*	Mixed, frigid Typic Udipsamments
Sinai*	Fine, smectitic, frigid Typic Hapluderts
Sioux*	Sandy-skeletal, mixed Udorthentic Haploborolls
Southam	Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls
Stirum	Coarse-loamy, mixed, superactive, frigid Typic Natraquolls
Svea	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Swenoda	Coarse-loamy, mixed, superactive Pachic Udic Haploborolls
Tiffany*	Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls
Tonka	Fine, smectitic, frigid Argiaquic Argialbolls
Towner	Sandy over loamy, mixed, superactive Udorthentic Haploborolls
Vallers	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Velva	Coarse-loamy, mixed, superactive Fluventic Haploborolls
Walsh	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Walum	Sandy, mixed Aquic Haploborolls
Wyard	Fine-loamy, mixed, superactive, frigid Typic Epiaquolls
Wyndmere	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed, superactive Udic Calciborolls

* Occur as minor components only

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetical 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 (Soil Survey Staff, 1993). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (Soil Survey Staff, 1975) and Keys to Soil Taxonomy (Soil Survey Staff, 1996a). Unless otherwise stated, colors in the descriptions are for moist soil and effervescence refers to disseminated lime throughout the horizon. Following the pedon description is the range of important characteristics of the soil series.

Arveson Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderate in the upper part and rapid in the lower part
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon:
Arveson fine sandy loam, 1,180 feet north and 1,500 feet west of the southeast corner of sec. 1, T. 144 N, R. 60 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; common very fine and few fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

Bkg1—9 to 16 inches; dark gray (5Y 4/1) fine sandy loam, gray (5Y5/1) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg2—16 to 23 inches; olive gray (5Y 5/2) fine sandy loam, light gray (5Y 7/1) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard and friable; slightly sticky and slightly plastic; few very fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg3—23 to 39 inches; olive gray (5Y 5/2) fine sandy loam, light gray (5Y 7/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—39 to 47 inches; olive gray (5Y 5/2) loamy fine sand, light olive gray (5Y 6/2) dry; moderate medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; soft and very friable; nonsticky and nonplastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—47 to 60 inches; olive gray (5Y 5/2) loamy fine sand, light olive gray (5Y 6/2) dry; many medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; soft and very friable; nonsticky and nonplastic; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 8 to 23 inches
Salinity: The soil is saline in some map units.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3

Bkg horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 5, 4 to 7 dry
Texture: fine sandy loam or loam
Notes: The lower part is loamy fine sand in some pedons.

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 1 or 2
Texture: fine sand, loamy fine sand, or fine sandy loam

Banks Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 6 percent

Taxonomic class: Sandy, mixed, frigid Typic Ustifluvents

Typical pedon: (Outside Griggs County)
Banks very fine sandy loam, 2,165 feet east and 1,585 feet south of the northwest corner of sec. 5, T. 140 N., R. 81 W.

A—0 to 4 inches; dark grayish brown (2.5Y 4/2) very fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak medium granular structure; very friable; common roots; slight effervescence throughout (HCl, unspecified); slightly alkaline; abrupt wavy boundary.

C1—4 to 30 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; few roots; slight effervescence throughout (HCl, unspecified); slightlt alkaline; abrupt wavy boundary.

C2—30 to 60 inches; dark grayish brown (2.5Y 4/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; slight effervescence throughout (HCl, unspecified); slightly alkaline; very thin (1/8 to 1/2 inch) bands of silt and very fine sand.

Range in Characteristics

Depth to lime: less than 10 inches
10 to 40 inch particle-size control section: mainly strata of loamy fine sand, fine sand, or sand
Notes: Some pedons have Ab horizons and some pedons have AC horizons.

A horizon:
Texture: ranges from sand to silty clay

C horizon:
Texture: loamy fine sand, fine sand, or sand

Barnes Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 25 percent

Taxonomic class: Fine-loamy, mixed, superactive Udic Haploborolls

Typical Pedon:
Barnes loam, in an area of Barnes-Svea loams, 3 to 6 percent slopes, 2,100 feet west and 2,510 feet south of the northeast corner of sec. 12, T. 144 N., R. 58 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw—9 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Bk—14 to 28 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 4 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C—28 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Notes: Some pedons have BCk horizons.

Ap horizon:
Value: 2 or 3, 3 or 4 dry
Texture: loam or fine sandy loam

Bw horizon:
Hue: 10YR or 2.5Y

Value: 3 or 4, 4 to 6 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bearden Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon:
Bearden silt loam, 1,350 feet north and 125 feet east of the southwest corner of sec. 13, T. 146 N., R. 59 E.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; soft and friable; slightly sticky and slightly plastic; many fine and very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

ABk—9 to 14 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; slight effervescence; moderately alkaline; clear wavy boundary.

Bk—14 to 20 inches; dark grayish brown (2.5Y 4/2) silt loam, grayish brown (2.5Y 5/2) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; common fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—20 to 42 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; hard and firm; slightly sticky and slightly plastic; few fine and very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 54 inches; olive brown (2.5Y 4/4) silt loam, light olive brown (2.5Y 5/4) dry; common fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; hard and firm; slightly sticky and slightly plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—54 to 60 inches; olive brown (2.5Y 4/4) silt loam, light olive brown (2.5Y 5/4) dry; common fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; hard and firm; slightly sticky and slightly plastic; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Salinity: The soil is saline in some map units.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4
Texture: silt loam or silty clay loam

C horizon:
Texture: silt loam or silty clay loam

Binford Series

Depth Class: Very deep
Drainage Class: Somewhat excessively drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 15 percent

Taxonomic class: Sandy, mixed Udic Haploborolls

Typical Pedon:
Binford sandy loam, in an area of Binford-Coe sandy loams, 0 to 6 percent slopes, 105 feet west and 215 feet south of the northeast corner of sec. 14, T. 148 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; soft and friable; slightly sticky and nonplastic; many very fine and few fine roots; about 5 percent gravel; about 8 percent shale in the 0.1 to 76 mm fraction; neutral; clear wavy boundary.

Bw1—8 to 12 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; soft and friable; slightly sticky and nonplastic; common very fine roots; about 5 percent gravel; about 10 percent shale in the 0.1 to 76 mm fraction; slightly alkaline; gradual wavy boundary.

Bw2—12 to 17 inches; olive brown (2.5Y 4/4) sandy loam, light olive brown (2.5Y 5/4) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; soft and friable; slightly sticky and nonplastic; common very fine roots; about 5 percent gravel; about 15 percent shale in the 0.1 to 76 mm fraction; slightly alkaline; clear wavy boundary.

2C—17 to 60 inches; dark grayish brown (10YR 4/2) gravelly coarse sand, grayish brown (10YR 5/2) dry; single grain; loose; nonsticky and nonplastic; about 30 percent gravel; about 55 percent shale in the 0.1 to 76 mm fraction; strong effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 14 to 25 inches
Notes: Some pedons have 2Bw or 2Bk horizons.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Value: 2 to 4, 4 to 6 dry

2C horizon:
Value: 4 or 5, 5 or 6 dry
Chroma: 2 to 4
Notes: It has 20 to 70 percent shale in the 0.1 to 76 mm fraction. It averages 5 to 35 percent gravel.

Brantford Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate in the upper part and very rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls

Typical Pedon:
Brantford loam, 0 to 3 percent slopes, 160 feet north and 715 feet east of the southwest corner of sec. 18, T. 147 N., R. 60 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak coarse granular structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bw1—8 to 12 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

Bw2—12 to 15 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

2C1—15 to 42 inches; dark grayish brown (2.5Y 4/2) very gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 50 percent gravel; about 60 percent shale in the 0.1 to 76 mm fraction; strong effervescence; moderately alkaline; diffuse wavy boundary.

2C2—42 to 60 inches; dark grayish brown (10YR 4/2) very gravelly coarse sand, light brownish gray (10YR 6/2) dry; single grain; loose; nonsticky and nonplastic; about 45 percent gravel; about 40 percent shale in the 0.1 to 76 mm fraction; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 8 to 16 inches
Depth to sand and gravel: 14 to 20 inches
Notes: Some pedons have a 2Bw or 2Bk horizon. They are gravelly loam or gravelly sandy loam.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 3 or 4

2C horizon
Value: 4 or 5, 5 or 6 dry
Chroma: 2 to 4
Notes: It has 20 to 85 percent shale in the 0.1 to 76 mm fraction. It averages 20 to 60 percent gravel.

Buse Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 3 to 35 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive Udic Calciborolls

Typical Pedon:
Buse loam, in an area of Barnes-Buse loams, 3 to 6 percent slopes, 1,525 feet west and 550 feet north of the southeast corner of sec. 13, T. 144 N., R. 58 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 4 percent gravel; slightly alkaline; abrupt wavy boundary.

Bk1—7 to 14 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; about 4 percent gravel; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—14 to 24 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; moderate coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 4 percent gravel; few medium masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches

Ap horizon:
Value: 2 or 3, 4 or 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 5
Texture: loam or clay loam

Cathay Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine-loamy, mixed, superactive Glossic Udic Natriborolls

Typical Pedon:
Cathay loam, in an area of Larson-Cathay loams, 0 to 3 percent slopes, 2,570 feet east and 2,485 feet south of the northwest corner of sec. 19, T. 148 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and few fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

E/B—8 to 10 inches; very dark grayish brown (10YR 3/2) (E) and very dark gray (10YR 3/1) (B) loam, dark grayish brown (10YR 4/2) (E) and dark gray (10YR 4/1) (B) dry; moderate coarse platy structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine and few fine roots; about 3 percent gravel; neutral; gradual wavy boundary.

Btn1—10 to 17 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry;

moderate medium prismatic structure parting to moderate medium angular blocky; hard and firm; sticky and plastic; few very fine roots; many distinct clay films and organic matter coats on faces of peds and in pores; dark gray (10YR 4/1) uncoated silt and sand grains on the tops and sides of prisms; about 6 percent gravel; neutral; gradual wavy boundary.

Btn2—17 to 22 inches; dark brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard and firm; sticky and plastic; few very fine roots; common distinct clay films and organic matter coats on faces of peds; about 2 percent gravel; neutral; gradual wavy boundary.

Bk—22 to 34 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 7 percent gravel; common fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/3) loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct olive yellow (2.5Y 6/6) redoximorphic concentrations and few medium faint light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; slightly hard and friable; slightly sticky and slightly plastic; about 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Notes: Some pedons have E or B/E horizons.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Btn horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6
Chroma: 2 to 4
Texture: loam or clay loam

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 or 5, 5 or 6 dry
Chroma: 2 to 4

Cavour Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic Udic Natriborolls

Typical Pedon:
Cavour loam, in an area of Cavour-Cresbard loams, 0 to 3 percent slopes, 1,525 feet west and 1,170 feet north of the southeast corner of sec. 33, T. 144 N., R. 61 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 4 percent gravel; neutral; abrupt smooth boundary.

A—6 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse platy structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 2 percent gravel; neutral; abrupt wavy boundary.

E—8 to 10 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate coarse platy structure; slightly hard and very friable; slightly sticky and slightly plastic; common very fine and few fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Btn—10 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate coarse columnar structure parting to strong coarse angular blocky; very hard and firm; very sticky and very plastic; common very fine and few fine compressed roots on ped faces; many distinct clay films on faces of peds and in pores; very dark grayish brown (10YR 3/2) uncoated sand and silt grains on top of columns; about 2 percent gravel; slightly alkaline; gradual wavy boundary.

Bkyz—20 to 27 inches; dark gray (10YR 4/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; about 2 percent gravel; common fine salt and gypsum crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk—27 to 39 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; common fine prominent yellow (2.5Y 7/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 10 percent gravel; common fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—39 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct light gray (2.5Y 7/2) redoximorphic depletions and yellow (2.5Y 7/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 14 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 9 to 30 inches
Depth to gypsum or other salts: 16 to 40 inches

A horizon:
Value: 2 to 4, 3 to 6 dry

E horizon:
Value: 2 to 4, 3 to 6 dry
Chroma: 1 or 2

Btn horizon:
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3
Texture: clay loam, silty clay, or silty clay loam

Bk horizon:
Texture: loam or clay loam

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

Coe Series

Depth Class: Very deep
Drainage Class: Excessively drained
Permeability: Moderately rapid in the upper part and very rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 25 percent

Taxonomic class: Sandy-skeletal, mixed Udorthentic Haploborolls

Typical Pedon:
Coe sandy loam, in an area of Binford-Coe sandy loams, 0 to 6 percent slopes, 185 feet west and 180 feet south of the northeast corner of sec. 14, T. 148 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak coarse granular structure; slightly hard and very friable; slightly sticky and nonplastic; many very fine and fine roots; about 8 percent gravel; about 15 percent shale in the 0.1 to 76 mm fraction; violent effervescence; slightly alkaline; abrupt smooth boundary.

C1—8 to 12 inches; dark grayish brown (2.5Y 4/2) very gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; common very fine and fine roots; about 35 percent gravel; about 60 percent shale in the 0.1 to 76 mm fraction; slight effervescence; slightly alkaline; gradual wavy boundary.

C2—12 to 32 inches; dark grayish brown (2.5Y 4/2) very gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; few very fine and fine roots; about 45 percent gravel; about 70 percent shale in the 0.1 to 76 mm fraction; slight effervescence; slightly alkaline; gradual wavy boundary.

C3—32 to 60 inches; dark grayish brown (2.5Y 4/2) very gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 40 percent gravel; about 50 percent shale in the 0.1 to 76 mm fraction; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 12 inches
Depth to sand and gravel: 6 to 14 inches
Notes: Some pedons have BK horizons.

Ap horizon:
Value: 2 or 3 , 3 to 5 dry
Texture: sandy loam or gravelly sandy loam

C horizon:
Value: 4 to 6, 5 to 7 dry
Texture: very gravelly loamy coarse sand, very gravelly coarse sand, or gravelly sand
Notes: It has 20 to 70 percent shale in the 0.1 to 76 mm fraction. It average 35 to 65 percent gravel.

Colvin Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon:
Colvin silt loam, 1,085 feet south and 815 feet west of the northeast corner of sec. 7, T. 148 N., R. 61 W.

A—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; strong effervescence; slightly alkaline; clear wavy boundary.

ABk—10 to 16 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry: weak coarse subangular blocky structure; hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg—16 to 30 inches; dark gray (5Y 4/1) silt loam, light gray (5Y 7/1) dry; weak coarse subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few fine and very fine roots; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Cg—30 to 60 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; many fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Salinity: The soil is saline in some map units.

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3, 3 or 4 dry
Chroma: 1 or less

Bkg horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 7, 5 to 8 dry
Chroma: 2 or less
Texture: silt loam or silty clay loam

Cg horizon:
Texture: silt loam or silty clay loam

Cresbard Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic Glossic Udic Natriborolls

Typical Pedon:
Cresbard loam, in an area of Cavour-Cresbard loams, 0 to 3 percent slopes, 1,220 feet west and 1,170 feet north of the southeast corner of sec. 33, T. 144 N., R. 61 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

A—8 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak coarse platy; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 3 percent gravel; neutral; clear wavy boundary.

B/E—12 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard and firm; slightly sticky and slightly plastic; common very fine and few fine roots; dark gray (10YR 4/1) clean silt and sand coatings on faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

Btn1—16 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate medium angular blocky; hard and firm; sticky and plastic; common very fine roots; many distinct clay films and organic matter coats on faces of peds and in pores; about 1 percent gravel; neutral; gradual wavy boundary.

Btn2—20 to 25 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to weak medium angular blocky; hard and firm; sticky and plastic; common very fine roots; common distinct clay films and organic matter coats on faces of peds; about 1 percent gravel; slightly alkaline; gradual wavy boundary.

Btn3—25 to 32 inches; dark grayish brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; moderate medium prismatic structure parting to weak medium angular blocky; hard and firm; slightly sticky and slightly plastic; few fine roots; few distinct clay films and organic matter coats on faces of peds; about 4 percent gravel; moderately alkaline; gradual wavy boundary.

Bk—32 to 43 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; common fine distinct olive yellow (2.5Y 6/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 10 percent gravel; few fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/3) loam, light yellowish brown (2.5Y 6/3) dry; common fine distinct light gray (2.5Y 7/2) redoximorphic depletions and yellow (2.5Y 7/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 8 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 12 to 28 inches
Notes: Some pedons have Btz horizons.

A horizon:
Value: 2 or 3, 3 or 4 dry

B/E horizon:
Texture: clay loam or silty clay loam

Btn horizon:
Hue: 10YR or 2.5Y
Chroma: 1 to 3
Texture: clay loam or silty clay

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: clay loam or loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: clay loam or loam

Darnen Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Valleys
Parent material: Glacial till
Slope: 3 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical pedon: (Outside Griggs County)
Darnen loam, 2,550 ft. west and 150 ft. north of the southeast corner of sec. 29, T. 122 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 24 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine pores; neutral; clear smooth boundary.

AB—24 to 29 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; many fine pores; neutral; clear smooth boundary.

Bw1—29 to 34 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw2—34 to 60 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; strong effervescence throughout (HCl, unspecified); slightly alkaline; gradual smooth boundary.

Range in Characteristics

Mollic epipedon thickness: 24 to 48 inches
Depth to lime: 20 to 60 inches
Notes: Some pedons have up to 5 percent rock fragments below 30 inches. Some pedons have a Bk horizon and/or a C horizon.

A horizon:
Texture: loam, silt loam, sandy loam, or clay loam

Bw horizon:
Texture: loam or clay loam

Dickey Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid in the upper part and moderate in the lower part
Landform: Till plains
Parent material: Eolian over glacial till
Slope: 1 to 25 percent

Taxonomic class: Sandy over loamy, mixed, superactive Udorthentic Haploborolls

Typical pedon: (Outside Griggs County)
Dickey loamy fine sand, 650 feet south and 100 feet west of the northeast corner of sec. 5, T. 153 N., R. 74 W.

A—0 to 12 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; soft and very friable; nonsticky and nonplastic; common fine roots throughout; slightly alkaline; clear wavy boundary.

Bw1—12 to 20 inches; brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; weak very coarse prismatic structure parting to weak fine and medium subangular blocky; soft and very friable; nonsticky and nonplastic; few fine roots throughout; neutral; clear wavy boundary.

Bw2—20 to 30 inches; brown (10YR 4/3) fine sand, brown (10YR 5/3) dry; single grain; nonsticky and nonplastic; few fine roots throughout; neutral; abrupt wavy boundary.

2Bk—30 to 42 inches; light olive brown (2.5Y 5/4) loam, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common lime concretions throughout; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

2C—42 to 60 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure; hard and friable; slightly sticky and slightly plastic; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to glacial till: 20 to 40 inches
Notes: Some pedons have AC, BC, or C horizons above the 2C horizon. Some pedons have 2BC horizons.

A horizon:
Texture: loamy fine sand, loamy sand, fine sandy loam, or sandy loam

Bw horizon:
Texture: loamy fine sand, fine sand, or loamy sand

2C horizon:
Texture: loam, clay loam, silt loam, or silty clay
Notes: It contains up to 10 percent rock fragments. A thin stone, cobble, or gravel line is at the upper boundary of the 2C horizon in some pedons.

Divide Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Moderate in the upper part and very rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon:
Divide loam, 0 to 3 percent slopes, 2,150 feet east and 55 feet south of the northwest corner of sec. 32, T. 146 N., R. 60 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 1 percent gravel; strong effervescence; slightly alkaline; clear wavy boundary.

Bk1—9 to 16 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium and coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 1 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—16 to 24 inches; light brownish gray (2.5Y 6/2) loam, white (2.5Y 8/2) dry; few fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak medium and coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; about 1 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

2C1—24 to 28 inches; dark yellowish brown (10YR 4/6) sandy loam, brownish yellow (10YR 6/6) dry; few fine prominent light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; soft and very friable; slightly sticky and nonplastic; few very fine roots; about 10 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

2C2—28 to 37 inches; dark grayish brown (2.5Y 4/2) gravelly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 20 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

2C3—37 to 56 inches; olive brown (2.5Y 4/4) coarse sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose; nonsticky and nonplastic; about 5 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

2C4—56 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 20 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 18 inches
Depth to sand and gravel: 20 to 40 inches
Notes: Some pedons have 2Bk horizons.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 1 or 2

2C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4
Notes: It has 20 to 70 percent shale in the 0.1 to 76 mm fraction. It averages 5 to 30 percent gravel.

Eckman Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 3 to 15 percent

Taxonomic class: Coarse-silty, mixed, superactive Udic Haploborolls

Typical Pedon:
Eckman silt loam, in an area of Gardena-Eckman silt loams, 3 to 6 percent slopes, 2,630 feet north and 165 feet east of the southwest corner of sec. 18, T. 145 N., R. 58 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear smooth boundary.

Bw1—8 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear wavy boundary.

Bw2—14 to 19 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate fine subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; slightly alkaline; clear wavy boundary.

Bk—19 to 27 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and slightly plastic; few fine and very fine roots; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C1—27 to 38 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline; clear wavy boundary.

C2—38 to 60 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; massive; soft and very friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 36 inches

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 6 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6, 6 to 8 dry
Chroma: 2 to 4
Texture: silt loam, very fine sandy loam, or loam

C horizon
Texture: silt loam, very fine sandy loam, or loam

Edgeley Series

Depth Class: Moderately deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Till plains and valleys
Parent material: Colluvium, glacial till, and materials weathered from shale bedrock
Slope: 0 to 35 percent

Taxonomic class: Fine-loamy, mixed, superactive Udic Haploborolls

Typical Pedon:
Edgeley loam, 3 to 6 percent slopes, 1,410 feet west and 1,020 feet south of the northeast corner of sec. 15, T. 147 N., R. 58 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak coarse granular structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine and few medium roots; about 4 percent gravel; neutral; clear smooth boundary.

Bw—8 to 15 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Bk1—15 to 24 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 3 percent gravel; few medium masses of lime; slight effervescence; slightly alkaline; gradual wavy boundary.

Bk2—24 to 32 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 3 percent gravel; common medium masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

2Cr1—32 to 39 inches; olive gray (5Y 4/2) weathered shale bedrock, light olive gray (5Y 6/2) dry; few roots in partings and on the surface of individual shale channers; few medium masses of lime; gradual wavy boundary.

2Cr2—39 to 60 inches; olive gray (5Y 4/2) weathered shale bedrock, light olive gray (5Y 6/2) dry.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to bedrock: 20 to 40 inches
Notes: Some pedons do not have Bk horizons. Some pedons have C horizons.

Ap horizon:
Value: 2 or 3, 3 or 4 dry
Texture: loam or silt loam

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 2 or 3
Texture: loam, silty clay loam, clay loam, or silt loam

Bk horizon:
Value: 4 or 5
Chroma: 1 or 2
Texture: silt loam, very fine sandy loam, or loam

2Cr horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 6 or 7 dry
Chroma: 2 or 3

Egeland Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderately rapid
Landform: Lake plains

Parent material: Glaciolacustrine and glaciofluvial deposits
Slope: 1 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive Udic Haploborolls

Typical Pedon:
Egeland fine sandy loam, in an area of Embden-Egeland fine sandy loams, 1 to 6 percent slopes, 550 feet north and 2,350 feet west of the southeast corner of sec. 18, T. 148 N., R. 60 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard and very friable; slightly sticky and nonplastic; common very fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 14 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and very friable; slightly sticky and nonplastic; common very fine roots; neutral; clear smooth boundary.

Bw2—14 to 25 inches; olive brown (2.5Y 4/3) fine sandy loam, light olive brown (2.5Y 5/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and very friable; slightly sticky and nonplastic; few very fine roots; about 1 percent gravel; neutral; gradual wavy boundary.

Bw3—25 to 31 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and very friable; slightly sticky and nonplastic; few very fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bw4—31 to 40 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; weak medium subangular blocky structure; soft and very friable; nonsticky and nonplastic; neutral; gradual wavy boundary.

Bk—40 to 50 inches; light olive brown (2.5Y 5/4) loamy fine sand, pale yellow (2.5Y 7/4) dry; single grain; loose; nonsticky and nonplastic; about 2 percent gravel; common fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C—50 to 60 inches; olive brown (2.5Y 4/4) loamy fine sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose; nonsticky and nonplastic; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 8 to 16 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry
Texture: loam or silt loam

Bw horizon:
Value: 2 to 5, 4 to 6 dry

Bk horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 3 or 4

Embden Series

Depth Class: Very deep
Drainage Class: Moderately well and well drained
Permeability: Moderately rapid
Landform: Lake plains and moraines
Parent material: Glaciolacustrine and glaciofluvial deposits
Slope: 0 to 9 percent

Taxonomic class: Coarse-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon
Embden fine sandy loam, 2,090 feet north and 2,515 feet west of the southeast corner of sec. 6, T. 148 N., R. 61 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and few fine roots; neutral; abrupt smooth boundary.

A—8 to 16 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and few fine roots; neutral; clear wavy boundary.

Bw1—16 to 22 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many very fine and few fine roots; neutral; clear wavy boundary.

Bw2—22 to 33 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

Bw3—33 to 38 inches; dark yellowish brown (10YR 4/4) fine sandy loam, yellowish brown (10YR 5/4) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard and very friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

C1—38 to 53 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard and very friable; slightly sticky and nonplastic; slightly alkaline; gradual wavy boundary.

C2—53 to 60 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent light olive gray (5Y 6/2) redoximorphic depletions and strong brown (7.5YR 5/6) redoximorphic concentrations; massive; slightly hard and very friable; slightly sticky and nonplastic; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 35 inches
Notes: Some pedons have Bk horizons.

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4
Chroma: 1 to 4

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: fine sandy loam or loamy fine sand

Emrick Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon:
Emrick loam, in an area of Heimdal-Emrick loams, 3 to 6 percent slopes, 580 feet north and 2,200 feet west of the southeast corner of sec. 27, T. 148 N., R. 61 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; soft and friable; slightly sticky and slightly plastic; many very fine and fine and few medium roots; about 4 percent gravel; neutral; clear wavy boundary.

A—8 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; soft and friable; slightly sticky and slightly plastic; many very fine, common fine, and few medium roots; about 4 percent gravel; neutral; clear wavy boundary.

Bw1—13 to 21 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 4 percent gravel; neutral; gradual wavy boundary.

Bw2—21 to 32 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to moderate coarse subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; about 4 percent gravel; neutral; clear wavy boundary.

Bk—32 to 45 inches; pale brown (10YR 6/3) loam, light gray (10YR 7/2) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots; about 4 percent gravel; common medium masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—45 to 60 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Notes: Some pedons have BCk horizons.

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Chroma: 2 or 3

Bk horizon:
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4
Texture: fine sandy loam or loamy fine sand

Enloe Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Argiaquic Argialbolls

Typical pedon: (Outside Griggs County)
Enloe silty clay loam, 800 feet east and 310 feet north of the southwest corner of sec. 17, T. 135 N., R. 48 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; cloddy structure parting to strong very fine and fine granular; very hard and firm; moderately sticky and very plastic; common fine roots throughout; many fine pores; medium acid; abrupt smooth boundary.

E—8 to 14 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 6/1) dry; weak coarse prismatic structure parting to moderate thin platy; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; common fine pores; medium acid; dark gray (10YR 4/1) uncoated silt and sand grains on faces of peds; abrupt wavy boundary.

Btg1—14 to 18 inches; black (5Y 2/1) clay, very dark gray (5Y 3/1) dry; very dark gray (5Y 3/1) crushed and rubbed and dark gray (5Y 4/1) crushed, dry; moderate very coarse prismatic structure parting to strong very fine and fine angular blocky; extremely hard and very firm; very sticky and very plastic; few fine roots throughout; common fine pores; slightly acid; abrupt wavy boundary.

Btg2—18 to 29 inches; very dark gray (5Y 3/1) clay, dark gray (5Y 4/1) dry; dark gray (5Y 4/1), crushed, gray (5Y 5/1) dry; moderate very coarse prismatic structure parting to strong fine angular blocky; extremely hard and very firm; very sticky and very plastic; few fine roots throughout; common fine pores; faces of peds are shiny when moist; slickensides in lower part; neutral; clear wavy boundary.

Btg3—29 to 40 inches; dark gray (5Y 4/1) clay, gray (5Y 6/1) dry; moderate very coarse prismatic structure parting to strong very fine and fine angular blocky; extremely hard and very firm; very sticky and very plastic; few fine roots throughout; common fine and medium pores; faces of peds have shiny pressure coatings; slickensides cross horizon at an angle of 10 to 15 degrees from vertical; slight effervescence throughout (HCl, unspecified); slightly alkaline; gradual wavy boundary.

Bkg—40 to 60 inches; olive gray (5Y 4/2) clay, light olive gray (5Y 6/2) dry; few fine olive brown (2.5Y 4/4) and common fine light yellowish brown (2.5Y 6/4) redoximorphic concentrations and common fine gray (5Y 6/1) redoximorphic depletions; moderate fine and medium angular blocky structure; extremely hard and firm; very sticky and very plastic; few fine roots throughout; common fine pores; few fine lime concretions; slight effervescence throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Depth to the E horizon: 7 to 14 inches
Notes: Some pedons contain glacial till below a depth of 40 inches. Some pedons have a Cg horizon.

Ap horizon:
Texture: silty clay loam or silty clay.

E horizon:
Texture: silty clay loam or silty clay

Btg horizon:
Notes: It has 45 to 60 percent clay.

Bkg horizon:
Texture: silty clay or clay.
Notes: It has a calcium carbonate equivalent of 6 to 20 percent.

Esmond Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Till plains, moraines, and valleys
Parent material: Glacial till
Slope: 6 to 35 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive Udic Calciborolls

Typical Pedon:
Esmond loam, in an area of Heimdal-Esmond loams, 6 to 9 percent slopes, 530 feet east and 740 feet north of the southwest corner of sec. 27, T. 148 N., R. 61 W.

Ap—0 to 4 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 5 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

A—4 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and common fine roots; about 5 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Bk—8 to 20 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; about 5 percent gravel; common medium masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C1—20 to 38 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; about 7 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—38 to 60 inches; olive brown (2.5Y 4/4) loam, pale olive (5Y 6/3) dry; massive; slightly hard and very friable; slightly sticky and slightly plastic; about 9 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches

A horizon:
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

Fairdale Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 6 percent
Notes: These soils are calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, calcareous, frigid Mollic Udifluvents

Typical pedon: (Outside Griggs County)
Fairdale silt loam,1,850 feet south and 250 feet east of the northwest corner of sec. 6, T. 155 N., R. 52 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few fine roots throughout; many fine pores; slight effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

C1—7 to 10 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few fine and coarse roots throughout; common fine pores; few worm casts; few fragments of snail shells; slight effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

C2—10 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few fine and coarse roots throughout; many fine pores; few worm casts; few snail shells; slight effervescence throughout (HCl, unspecified); slightly alkaline; clear smooth boundary.

C3—16 to 48 inches; dark grayish brown (2.5Y 4/2) and brown (10YR 5/3) stratified silt loam and very fine sandy loam, light brownish gray (2.5Y 6/2) and very pale brown (10YR 7/3) dry; weak medium and coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots throughout; common fine pores; few fine irregular white (10YR 8/1) masses of lime and few fine brown (7.5YR 5/4) masses of iron accumulation; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

Ab1—48 to 60 inches; very dark brown (10YR 2/2) and very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; common fine pores; few fine brown (7.5YR 5/4) masses of iron accumulation; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

Ab2—60 to 67 inches; black (10YR 2/1) and olive brown (2.5Y 4/3) silty clay loam, dark gray (10YR 4/1) dry; massive; hard and friable; moderately sticky and moderately plastic; many fine irregular white (10YR 8/1) masses of lime; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C'1—67 to 80 inches; brown (10YR 4/3) and grayish brown (2.5Y 5/2) silty clay loam, light yellowish brown (2.5Y 6/3) dry; massive; hard and firm; moderately sticky and moderately plastic; many fine white (10YR 8/1) masses of lime; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Depth to the Ab horizon: Greater than 12 inches
Notes: Some pedons have sand below a depth of 40 inches.

Ap horizon:
Texture: silt loam, loam, fine sandy loam, very fine sandy loam, silty clay loam, silty clay, or clay loam

C horizon:
Texture: averages loam or silt loam above a depth of 60 inches

Ab horizon:
Notes: Some pedons do not have an Ab horizon.

Ferney Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Very slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic Leptic Natriborolls

Typical Pedon:
Ferney loam, 0 to 3 percent slopes, 335 feet south and 430 feet east of the northwest corner of sec. 10, T. 148 N., R. 60 W.

E—0 to 5 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium platy structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and few fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Btn—5 to 8 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; strong medium columnar structure parting to strong fine angular blocky; hard and firm; sticky and plastic; many very fine and few fine roots on compressed ped faces; many distinct clay films and organic matter coats on faces of peds and in pores; gray (10YR 5/1) coatings of silt and sand on tops of columns; about 3 percent gravel; moderately alkaline; clear wavy boundary.

Btnz—8 to 13 inches; dark brown (10YR 3/3) clay loam, dark brown (10YR 4/3) dry; moderate medium prismatic structure parting to strong fine angular blocky; hard and firm; sticky and plastic; common very fine and fine roots on ped faces; common distinct clay films and organic matter coats on faces of peds and in pores; about 2 percent gravel; many fine flecks and filaments of salt; moderately alkaline; clear smooth boundary.

Bkyz1—13 to 19 inches; light olive brown (2.5Y 5/3) clay loam, pale yellow (2.5Y 7/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard and firm; sticky and plastic; few very fine roots; about 3 percent gravel; common fine flecks of salt; common nests of gypsum crystals; few fine masses of lime; violent effervescence; strongly alkaline; gradual wavy boundary.

Bkyz2—19 to 25 inches; olive brown (2.5Y 4/3) clay loam, light yellowish brown (2.5Y 6/3) dry; weak coarse subangular blocky structure; hard and firm; sticky and plastic; about 3 percent gravel; common fine flecks of salt; common nests of gypsum crystals; few fine masses of lime; violent effervescence; strongly alkaline; clear smooth boundary.

Bkyz3—25 to 34 inches; olive brown (2.5Y 4/3) clay loam, pale yellow (2.5Y 7/3) dry; common medium faint dark grayish brown (2.5Y 4/2) redoximorphic depletions and few medium distinct yellowish brown (10YR 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; hard and firm; sticky and plastic; about 5 percent gravel; few fine flecks of salt; common nests of gypsum crystals; few fine masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/3) clay loam, pale yellow (2.5Y 7/3) dry; common fine distinct olive gray (5Y 4/2) redoximorphic depletions and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; about 8 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches
Depth to gypsum or other salts: 5 to 16 inches
Notes: Some pedons have an A horizon.

E horizon:
Value: 3 or 4, 4 to 7 dry
Chroma:1 or 2

Btn horizon:
Hue:10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Value: 4 or 5, 5 to 8 dry
Chroma: 2 to 4
Texture: loam or clay loam

Fossum Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Sandy, mixed, calcareous, frigid Typic Endoaquolls

Typical pedon: (Outside Griggs County)
Fossum sandy loam, 1,100 feet east and 160 feet south of the northwest corner of sec. 25, T. 122 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slight effervescence throughout (HCl, unspecified); moderately alkaline; abrupt smooth boundary.

A1—8 to 13 inches; very dark gray (N 3/0) loamy sand, dark gray (N 4/0) dry; massive; very friable; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

A2—13 to 21 inches; very dark grayish brown (2.5Y 3/2) sand, dark grayish brown (2.5Y 4/2) dry; single grain; loose; common fine faint gray (5Y 5/1) redoximorphic depletions and brown (10YR 5/3) redoximorphic concentrations; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

Cg1—21 to 26 inches; olive gray (5Y 5/2) fine sand; single grain; loose; common medium distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

Cg2—26 to 60 inches; light olive gray (5Y 6/2) fine sand; single grain; loose; common coarse prominent brownish yellow (10YR 6/8) redoximorphic concentrations; strong effervescence on upper surfaces of peds or rocks (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Depth to lime: 0 to 10 inches
Depth to loamy fine sand or coarser material: less than 20 inches
Notes: Some pedons have a Bk horizon, but it has a calcium carbonate equivalent of less than 15 percent. Some pedons have glacial till or up to 35 percent gravel below a depth of 40 inches.

A horizon:
Texture: loamy sand, loamy fine sand, sandy loam, fine sandy loam, or loam
Notes: The texture of the lower part can also be sand or fine sand. The calcium carbonate equivalent is less than 15 percent.

Cg horizon:
Texture: sand, fine sand, loamy sand, or loamy fine sand

Fram Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon:
Fram loam, in an area of Fram-Wyard loams, 0 to 3 percent slopes, 400 feet east and 530 feet north of the southwest corner of sec. 31, T. 145 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; soft and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 3 percent gravel; slightly alkaline; abrupt smooth boundary.

Ak—9 to 18 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine and few medium roots; about 3 percent gravel; common fine and medium masses of lime; strong effervescence; slightly alkaline; clear wavy boundary.

Bk—18 to 27 inches; light brownish gray (2.5Y 6/2) loam, white (2.5Y 8/2) dry; weak coarse subangular blocky structure; soft and friable; slightly sticky and slightly plastic; few very fine and fine roots; about 3 percent gravel; common fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C—27 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; many fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and grayish brown (2.5Y 5/2) redoximorphic depletions; massive; slightly hard and friable; slightly sticky and slightly plastic; about 3 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Notes: Some pedons have a Bky or BCk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Ak horizon:
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 8 dry
Chroma: 1 to 4

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

Gardena Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 6 percent

Taxonomic class: Coarse-silty, mixed, superactive, frigid Pachic Udic Haploborolls

Typical Pedon:
Gardena silt loam, 0 to 3 percent slopes, 250 feet north and 525 feet east of the southwest corner of sec. 18, T. 145 N., R. 58 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear smooth boundary.

Bw1—9 to 18 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; neutral; clear wavy boundary.

Bw2—18 to 24 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; slightly alkaline; clear wavy boundary.

Bk1—24 to 29 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and slightly plastic; few fine and very fine roots; few fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—29 to 37 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine and very fine roots; few fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions; massive; slightly hard and friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 40 inches
Depth to lime: 20 to 40 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Texture: silt loam or very fine sandy loam

C horizon:
Texture: silt loam or very fine sandy loam

Gilby Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glaciofluvial deposits over glacial till
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon: (Outside Griggs County)
Gilby loam, 1,150 feet north and 250 feet east of the southwest corner of sec. 12, T. 156 N., R. 55 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common roots throughout; many fine pores; strong effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

A—6 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; few fine faint very dark gray (10YR 3/1) redoximorphic concentrations; moderate medium subangular blocky structure; friable; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

Bk1—10 to 18 inches; gray (10YR 5/1) loam, light gray (10YR 7/1) dry; weak medium prismatic and medium and fine subangular blocky structure; friable; violent effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

Bk2—18 to 24 inches; olive (5Y 5/3) very fine sandy loam, light gray (2.5Y 7/2) dry; few medium distinct yellowish brown (10YR 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; friable; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C1—24 to 33 inches; light olive brown (2.5Y 5/4) very fine sandy loam, pale yellow (2.5Y 7/4) dry; few fine faint light brownish gray (2.5Y 6/2) redoximorphic depletions and distinct yellowish brown (10YR 5/4) redoximorphic concentrations; massive; friable; violent effervescence throughout (HCl, unspecified); moderately alkaline; abrupt wavy boundary.

2C2—33 to 60 inches; light olive brown (2.5Y 5/4), olive gray (5Y 4/2), and light brownish gray (2.5Y 6/2) clay loam; many medium prominent reddish brown (2.5YR 5/3) redoximorphic concentrations; massive; firm; common gypsum crystals; strong effervescence throughout (HCl, unspecified); moderately alkaline; few pebbles and stones; few small shale fragments.

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches
Depth to glacial till: 20 to 40 inches
Percent rock fragments: up to 10 percent pebbles, cobbles and stones
Notes: Some pedons have a thin layer of sandy, gravelly, or stony material at the contact between the C and 2C horizon. Some pedons have a 2Bk, 2Bky, or 2By horizon.

A horizon:
Texture: loam, silt loam, or silty clay loam

Bk horizon:
Texture: loam, silt loam, very fine sandy loam, or clay loam

C horizon:
Texture: very fine sandy loam, loam, or silt loam

2C horizon
Texture: loam or clay loam

Great Bend Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Galciolacustrine deposits
Slope: 3 to 15 percent

Taxonomic class: Fine-silty, mixed, superactive Udic Haploborolls

Typical pedon: (Outside Griggs County)
Great Bend silt loam, 1,100 feet south and 130 feet east of the northwest corner of sec. 29, T. 122 N., R. 62 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard and friable; common fine roots throughout; neutral; abrupt smooth boundary.

Bw—8 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard and friable; few fine roots throughout; neutral; clear wavy boundary.

Bk1—13 to 17 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard and very friable; few roots throughout; many fine pores; strong effervescence throughout (HCl, unspecified); slightly alkaline; clear wavy boundary.

Bk2—17 to 29 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak coarse and medium subangular blocky structure; slightly hard and very friable; few roots throughout; many fine pores; few fine gypsum threads; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C1—29 to 46 inches; light yellowish brown (2.5Y 6/4) and olive brown (2.5Y 4/4) silt loam, light gray (2.5Y 7/2) and light olive brown (2.5Y 5/4) dry; massive; slightly hard and friable; strong effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C2—46 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, pale yellow (2.5Y 8/2) dry; common fine distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) redoximorphic concentrations; massive; slightly hard and friable; few fine iron-manganese concretions and few fine gypsum threads; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 32 inches
Notes: Stratified loamy sand or glacial till is below a depth of 40 inches in some pedons.

Ap horizon:
Texture: silt loam or silty clay loam

Bw horizon:
Texture: silt loam or silty clay loam

Bk horizon:
Texture: silt loam or silty clay loam

C horizon:
Texture: silt loam or silty clay loam
Notes: The calcium carbonate equivalent ranges from 10 to 26 percent. It is varved with thin strata of very fine sand to clay in the lower part of some pedons.

Grimstad Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid in the upper part and moderate in the lower part
Landform: Till plains
Parent material: Glaciofluvial deposits over glacial till
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Sandy over loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon: (Outside Griggs County)
Grimstad sandy loam, 1,425 feet west and 285 feet south of the northeast corner of sec. 2, T. 145 N., R. 45 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; few roots throughout; few very dark brown (10YR 2/2) worm casts; strong effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

Bk1—9 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand; weak fine granular structure; very friable; few roots throughout; strong effervescence throughout (HCl, unspecified); many very dark grayish brown (10YR 3/2) tongues and masses of lime disseminated throughout; slightly alkaline; gradual smooth boundary.

Bk2—14 to 22 inches; grayish brown (2.5Y 5/2) loamy sand; weak fine granular structure; very friable; few roots throughout; few dark yellowish brown (10YR 4/4) coatings on mineral grains in lower part; common dark grayish brown (10YR 4/2) masses of manganese accumulation; violent effervescence throughout (HCl, unspecified); slightly alkaline; clear wavy boundary;

C1—22 to 28 inches; light olive brown (2.5Y 5/4) loamy fine sand; common fine faint light yellowish brown (2.5Y 6/4) and few coarse distinct brown (10YR 4/3) redoximorphic concentrations; massive; loose; few roots throughout; slight effervescence throughout (HCl, unspecified); about 2 percent gravel in lower part; slightly alkaline; clear smooth boundary.

2C2—28 to 32 inches; brownish yellow (10YR 6/6) fine sandy loam; massive; very friable; few roots throughout; common fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations and light brownish gray (2.5Y 6/2) redoximorphic depletions; about 2 percent gravel; slight effervescence throughout (HCl, unspecified); slightly alkaline; clear smooth boundary.

2C3—32 to 60 inches; light brownish gray (2.5Y 6/2) fine sandy loam; common fine faint light gray (2.5Y 7/2) redoximorphic depletions and many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; few fine reddish brown concretions; massive; very friable; about 5 percent gravel; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: Occurs throughout the soil
Percent rock fragments: None in most horizons above the 2C horizon
Depth to glacial till: 20 to 40 inches

Ap horizon:
Texture: loamy sand, loamy fine sand, loamy very fine sand, sandy loam, fine sandy loam, very fine sandy loam, or loam.

C horizon:
Notes: It contains 0 to 10 percent rock fragments.

2C horizon:
Notes: A thin pebble band is at the top of the horizon in some pedons.

Hamar Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Eolian
Slope: 0 to 1 percent

Taxonomic class: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon:
Hamar loamy fine sand, in an area of Hamar-Hecla loamy fine sands, 2,400 feet north and 2,260 feet east of the southwest corner of sec. 6, T. 145 N., R. 59 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; many fine and very fine roots; neutral; abrupt smooth boundary.

A1—9 to 13 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; common fine distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; common fine and very fine roots; neutral; gradual wavy boundary.

A2—13 to 17 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; common fine distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; common fine and very fine roots; neutral; clear wavy boundary.

AB—17 to 25 inches; very dark grayish brown (2.5Y 3/2) loamy fine sand, grayish brown (2.5Y 5/2) dry; many medium distinct light brownish gray (2.5Y 6/2) redoximorphic depletions and common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine and very fine roots; slightly alkaline; clear wavy boundary.

Bk—25 to 46 inches; light brownish gray (2.5Y 6/2) loamy fine sand, white (2.5Y 8/2) dry; many fine prominent light gray (N 7/0) redoximorphic depletions and distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C—46 to 60 inches; grayish brown (2.5Y 5/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; many fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations and faint light brownish gray (2.5Y 6/2) redoximorphic depletions; single grain; loose; nonsticky and nonplastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 20 inches
Depth to lime: 22 to 40 inches

A horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5 dry
Chroma: 1 or 2

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 1 or 2
Texture: loamy fine sand, loamy sand, or fine sand

C horizon:
Texture: loamy fine sand, loamy sand, or fine sand

Hamerly Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These are highly calcareous soils.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon:
Hamerly loam, in an area of Hamerly-Wyard loams, 0 to 3 percent slopes, 265 feet north and 2,400 feet west of the southeast corner of sec. 31, T. 144 N., R. 61 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 3 percent gravel; very slight effervescence; slightly alkaline; clear smooth boundary.

ABk—10 to 15 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 3 percent gravel; common fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk1—15 to 21 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; about 3 percent gravel; many fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—21 to 29 inches; olive (5Y 5/3) loam, pale yellow (5Y 7/3) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; about 3 percent gravel; common fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—29 to 38 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—38 to 52 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 5 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C3—52 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 5 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Salinity: The soil is saline in some map units.
Notes: Some pedons have a BCk horizon.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 or 4 dry

ABk horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 or 4 dry
Chroma: 1 or 2

Bk horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6, 4 to 8 dry
Chroma: 1 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Harriet Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic, frigid Typic Natraquolls

Typical Pedon:
Harriet silt loam, 2,305 feet south and 650 feet east of the northwest corner of sec. 18, T. 147 N., R. 59 W.

E—0 to 2 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine platy structure; soft and friable; slightly sticky and slightly plastic; many very fine and few fine roots; neutral; abrupt smooth boundary.

Btn1—2 to 7 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate coarse columnar structure parting to moderate coarse angular blocky; very hard and firm; sticky and plastic; common very fine and few fine roots on ped faces; many distinct clay films and organic matter coats on faces of peds and in pores; dark gray (10YR 4/1) coatings of silt and sand on tops of columns; slightly alkaline; clear wavy boundary.

Btn2—7 to 10 inches; very dark gray (5Y 3/1) silty clay, dark gray (5Y 4/1) dry; moderate coarse prismatic structure parting to moderate medium angular blocky; very hard and firm; sticky and plastic; common very fine roots; common distinct clay films and organic matter coats on faces of peds and in pores; moderately alkaline; gradual wavy boundary.

Bkz1—10 to 18 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard and firm; sticky and plastic; few very fine roots; common fine flecks and threads of salts; few fine masses of lime; violent effervescence; strongly alkaline; gradual wavy boundary.

Bkz2—18 to 35 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; common medium prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; weak coarse prismatic structure parting to moderate coarse subangular blocky; very hard and firm; sticky and plastic; common fine flecks and threads of salts; few fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—35 to 47 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and many medium prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; massive; very hard and firm; sticky and plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—47 to 60 inches; olive (5Y 5/3) silty clay loam, pale olive (5Y 6/3) dry; common medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions and many medium prominent olive yellow (2.5Y 6/6) and light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; very hard and firm; sticky and plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 8 to 16 inches
Depth to gypsum or other salts: 5 to 11 inches
Notes: Some pedons have an A horizon.

E horizon:
Value: 3 or 4, 4 to 7 dry

Btn horizon:
Value: 2 to 4, 4 or 5 dry
Chroma: 1 to 2

C horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 1 to 3

Hecla Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Eolian
Slope: 0 to 3 percent

Taxonomic class: Sandy, mixed Aquic Haploborolls

Typical Pedon:
Hecla loamy fine sand, in an area of Maddock-Hecla loamy fine sands, 1 to 6 percent slopes, 890 feet south and 2,360 feet east of the northwest corner of sec. 22, T. 146 N., R. 58 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; many very fine and fine roots; neutral; clear smooth boundary.

A—10 to 25 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; common very fine and fine roots; neutral; clear wavy boundary.

AC—25 to 32 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; soft and very friable; nonsticky and nonplastic; few very fine and fine roots; neutral; clear wavy boundary.

C1—32 to 40 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; common fine distinct light brownish gray (10YR 6/2) redoximorphic depletions and few medium faint dark yellowish brown (10YR 4/4) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; slight effervescence; slightly alkaline; clear wavy boundary.

C2—40 to 60 inches; grayish brown (10YR 5/2) fine sand, light gray (10YR 7/2) dry; common medium faint light brownish gray (10YR 6/2) redoximorphic depletions and distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 20 inches

A horizon:
Value: 2 or 3

AC horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2
Texture: loamy fine sand or fine sand

C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 2 to 4

Heimdal Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 25 percent

Taxonomic class: Coarse-loamy, mixed, superactive Udic Haploborolls

Typical Pedon:
Heimdal loam, in an area of Heimdal-Emrick loams, 3 to 6 percent slopes, 335 feet north and 2,150 feet west of the southeast corner of sec. 27, T. 148 N., R. 61 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; soft and friable; slightly sticky and slightly plastic; many very fine roots; about 4 percent gravel; neutral; abrupt smooth boundary.

Bw—7 to 14 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; soft and friable; slightly sticky and slightly plastic; common very fine roots; about 4 percent gravel; neutral; clear wavy boundary.

Bk—14 to 30 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak coarse subangular blocky structure; soft and friable; slightly sticky and slightly plastic; about 4 percent gravel; common medium masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—30 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; few fine masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Notes: Some pedons have a BCk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 6 dry
Chroma: 2 to 4

Bk horizon:
Value: 4 or 5, 4 to 7 dry
Chroma: 2 to 4

C horizon:
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4

Kensal Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderate over rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 1 percent

Taxonomic class: Fine-loamy over sandy or sandy skeletal, mixed, superactive Aquic Haploborolls

Typical Pedon:
Kensal loam, 2,505 feet north and 550 feet west of the southeast corner of sec. 24, T. 147 N., R. 61 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 14 inches; very dark grayish brown (2.5Y 3/2) loam, dark grayish brown (2.5Y 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many fine and very fine roots; few pebbles; neutral; clear wavy boundary.

Bw2—14 to 19 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; few medium distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and faint light brownish gray (2.5Y

6/2) redoximorphic depletions; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common fine and very fine roots; about 2 percent gravel; neutral; clear wavy boundary.

2Bw3—19 to 23 inches; dark grayish brown (2.5Y 4/2) gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; common fine faint light brownish gray (2.5Y 6/2) redoximorphic depletions and distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; slightly hard and very friable; slightly sticky and nonplastic; few fine and very fine roots; about 15 percent gravel; about 25 percent shale in the 0.1 to 76 mm fraction; neutral; clear wavy boundary.

2C—23 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; nonsticky and nonplastic; about 30 percent gravel; about 55 percent shale in the 0.1 to 76 mm fraction; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 20 to 38 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Chroma: 2 or 3
Notes: It averages 5 to 20 percent gravel.

2C horizon:
Notes: It has more than 20 percent shale in the 0.1 to 76 mm fraction. It averages 5 to 20 percent gravel.

Kloten Series

Depth Class: Shallow
Drainage Class: Well drained
Permeability: Moderate
Landform: Till plains and valleys
Parent material: Weathered shale
Slope: 6 to 35 percent

Taxonomic class: Loamy, mixed, superactive, shallow Udorthentic Haploborolls

Typical Pedon:
Kloten silt loam, in an area of Edgeley-Kloten-Esmond complex, 9 to 35 percent slopes, 1,290 feet south and 395 feet west of the northeast corner of sec. 15, T. 147 N., R. 58 W.

A—0 to 11 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 12 percent shale channers; neutral; clear wavy boundary.

Cr—11 to 60 inches; dark gray (5Y 4/1) weathered shale bedrock, gray (5Y 5/1) dry.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches
Depth to bedrock: 9 to 20 inches
Notes: Some pedons have an AC horizon.

A horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

LaDelle Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 3 percent

Taxonomic class: Fine-silty, mixed, superactive Cumulic Udic Haploborolls

Typical Pedon:
LaDelle silty clay loam, 0 to 3 percent slopes, 225 feet east and 390 feet north of the southwest corner of sec. 10, T. 145 N., R. 58 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; slightly hard and firm; sticky and plastic; common very fine and fine roots; neutral; clear wavy boundary.

A—9 to 23 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; slightly hard and firm; sticky and plastic; common very fine and fine roots; neutral; gradual wavy boundary.

Bw—23 to 34 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard and firm; sticky and plastic; few very fine and fine roots; slightly alkaline; gradual wavy boundary.

Ab—34 to 43 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; slightly hard and firm; sticky and plastic; slightly alkaline; abrupt smooth boundary.

Bwb—43 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak coarse subangular blocky structure; hard and firm; sticky and plastic; few very fine and fine roots; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 17 to 45 inches
Notes: Some pedons have a C horizon

A horizon:
Value: 2 or 3

Lamoure Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Typical Pedon:
Lamoure silt loam, in an area of Lamoure and Rauville silt loams, 2,600 feet east and 400 feet south of the northwest corner of sec. 9, T. 146 N., R. 61 W.

A1—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; soft and friable; sticky and plastic; many very fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

A2—9 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard and friable; sticky and plastic; common very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Ag—18 to 30 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; weak medium subangular blocky structure; slightly hard and friable; sticky and plastic; few very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—30 to 60 inches; dark gray (5Y 4/1) silty clay loam, light gray (5Y 6/1) dry; massive; slightly hard and firm; sticky and plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to 40 inches

A horizon:
Value: 3 to 5 dry

Cg horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 to 6, 5 to 8 dry
Chroma: 2 or less
Texture: silty loam or silty clay loam

Lankin Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glaciolacustrine deposits over glacial till
Slope: 1 to 3 percent

Taxonomic class: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical pedon: (Outside Griggs County)
Lankin loam, 825 feet east and 110 feet north of southwest corner of sec. 8, T. 156 N., R. 54 W.

A—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and coarse subangular blocky structure parting to weak very fine subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common roots throughout; many fine pores; neutral; clear smooth boundary.

Bw1—11 to 17 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak coarse prismatic structure parting to weak and moderate medium subangular blocky; hard and friable; slightly sticky and slightly plastic; few roots; common fine pores; neutral; gradual smooth boundary.

Bw2—17 to 21 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; common fine faint gray (5Y 5/1) and few fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions; weak coarse prismatic structure parting to weak fine subangular blocky; hard and friable; slightly sticky and slightly plastic; few roots throughout; common fine pores; slightly alkaline; clear wavy boundary.

2Bw3—21 to 24 inches; very dark grayish brown (2.5Y 3/2) loam, grayish brown (2.5Y 5/2) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; lime concretions around stones and few masses of lime; slightly effervescent throughout (HCl, unspecified); 1 percent gravel and 1 percent stones; intermittent lenses of sand; slightly alkaline; clear irregular boundary.

2Bk—24 to 38 inches; light brownish gray (2.5Y 6/2) clay loam, pale yellow (2.5Y 8/2) dry; common medium distinct gray (5Y 5/1) and common fine prominent olive gray (5Y 5/2) redoximorphic depletions and common medium distinct olive brown (2.5Y 4/4) and common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; weak fine and medium subangular blocky structure; hard and firm; slightly sticky and slightly plastic; about 5 percent rock fragments; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

2C—38 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light yellowish brown (2.5Y 6/4) dry; many medium prominent gray (5Y 5/1) redoximorphic depletions and many medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; very hard and firm; moderately sticky and moderately plastic; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Depth to glacial till: 20 to 40 inches
Notes: A sandy, gravelly, or stony layer is at the contact between the glaciolacustrine deposits and the glacial till in most pedons. Some pedons have a Bk horizon.

Bw horizon:
Texture: loam, silt loam, or clay loam

2Bw horizon:
Notes: Some pedons do not have a 2Bw horizon

2Bk horizon:
Texture: loam or clay loam

2C horizon:
Texture: loam or clay loam
Notes: It contains 2 to 10 percent rock fragments.

Larson Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Slow in the upper part and moderate in the lower part
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine-loamy, mixed, superactive Udic Natriborolls

Typical Pedon:
Larson loam, in an area of Larson-Cathay loams, 0 to 3 percent slopes, 2,480 feet south and 2,570 feet east of the northwest corner of sec. 19, T. 148 N., R. 59 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and few fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

E—6 to 8 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; moderate coarse subangular blocky structure parting to weak medium platy; slightly hard and friable; slightly sticky and slightly plastic; common very fine and few fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Btn1—8 to 13 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse columnar structure parting to moderate medium angular blocky; very hard and firm; sticky and plastic; common very fine compressed roots on ped faces; many distinct clay films and organic matter coats on faces of peds and in pores; light brownish gray

(10YR 6/2) uncoated sand and silt grains on tops of columns; about 1 percent gravel; slightly alkaline; gradual wavy boundary.

Btn2—13 to 17 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard and firm; sticky and plastic; common very fine compressed roots on ped faces; common distinct clay films on faces of peds; about 2 percent gravel; moderately alkaline; gradual wavy boundary.

Btkny—17 to 21 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate coarse subangular blocky; hard and friable; slightly sticky and slightly plastic; few very fine roots; few distinct clay films on faces of peds; about 5 percent gravel; common fine nests of gypsum; strong effervescence; strongly alkaline; gradual wavy boundary.

Bk—21 to 43 inches; light olive brown (2.5Y 5/3) loam, pale yellow (2.5Y 7/3) dry; hard and friable; slightly sticky and slightly plastic; few very fine roots; about 5 percent gravel; common fine masses of lime; violent effervescence; strongly alkaline; gradual wavy boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/3) loam, light yellowish brown (2.5Y 6/3) dry; common fine faint light brownish gray (2.5Y 6/2) redoximorphic depletions and prominent yellowish brown (10YR 5/8) redoximorphic concentrations; hard and friable; slightly sticky and slightly plastic; about 5 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 9 to 26 inches
Notes: Some pedons have a Bky horizon.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

E horizon:
Hue: 10YR to 2.5Y
Value: 2 to 4, 5 to 7 dry
Chroma: 1 to 3

Btn horizon:
Value: 2 to 4
Chroma: 1 to 3

Bk horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 or 3

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

Lemert Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are saline-sodic.

Taxonomic class: Coarse-loamy, mixed, superactive Leptic Natriborolls

Typical pedon: (Outside Griggs County)
Lemert sandy loam, 2,540 feet north and 900 feet west of the southeast corner of sec. 36, T. 149 N., R. 65 W.

A—0 to 3 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium granular structure; slightly hard and very friable; slightly sticky and slightly plastic; common fine roots throughout; neutral; abrupt smooth boundary.

Btn1—3 to 7 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; strong medium columnar structure parting to strong medium subangular blocky; extremely hard and firm; moderately sticky and moderately plastic; few fine roots throughout; few clay films on faces of peds and in pores; 1 percent gravel; strongly alkaline; gradual wavy boundary.

Btn2—7 to 12 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; strong medium prismatic structure parting to strong medium subangular blocky; extremely hard and firm; moderately sticky and moderately plastic; few fine roots throughout; common clay films on faces of peds; few rock fragments as much as 5 mm in size; strong effervescence throughout (HCl, unspecified); light gray (10YR 7/1) diffuse lime on interior of peds; very strongly alkaline; clear wavy boundary.

Bky—12 to 17 inches; light gray (N 7/0) loam, white (N 8/0) dry; few fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; weak medium prismatic structure parting to moderate medium subangular blocky; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; gray (N 5/0) coats on faces of peds; 1 percent gravel; few nests of gypsum and few masses of lime; violent effervescence throughout (HCl, unspecified); strongly alkaline; gradual wavy boundary.

Bkyz—17 to 22 inches; light brownish gray (2.5Y 6/2) loam, light gray (N 7/0) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; 1 percent gravel; common fine gypsum crystals and few masses of lime; violent effervescence throughout (HCl, unspecified); very strongly alkaline; clear wavy boundary.

2C1—22 to 49 inches; olive brown (2.5Y 4/4) coarse sand, light olive brown (2.5Y 5/4) dry; single grain; loose; nonsticky and nonplastic; 10 percent gravel; slight effervescence throughout (HCl, unspecified); strongly alkaline; clear wavy boundary.

3C2—49 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; massive; hard and firm; moderately sticky and moderately plastic; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Depth to sandy material: 20 to 40 inches
Notes: Some pedons have a sandy loam or fine sandy loam E horizon. Some pedons have Bkz, Bz, or BC horizons. Some pedons have a fine sandy loam C horizon instead of 2C and 3C horizons.

A horizon:
Texture: sandy loam or fine sandy loam

Btn horizon:
Texture: sandy loam, fine sandy loam, or loam

Bky horizon:
Texture: loam or sandy loam

2C horizon:
Texture: coarse sand, sand, loamy fine sand, or fine sand
Notes: It contains up to 20 percent gravel.

Letcher Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Slow over moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Coarse-loamy, mixed, superactive Udic Natriborolls

Typical Pedon:
Letcher fine sandy loam, in an area of Letcher-Swenoda fine sandy loams, 0 to 3 percent slopes, 990 feet west and 2,100 feet north of the southeast corner of sec. 31, T. 148 N., R. 59 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and few fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

E—8 to 9 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to moderate coarse platy; slightly hard and very friable; slightly sticky and slightly plastic; common very fine and few fine roots; neutral; clear smooth boundary.

Btn—9 to 18 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate coarse columnar structure parting to moderate medium angular blocky; very hard and firm; slightly sticky and slightly plastic; few very fine and fine roots; many distinct clay films and organic matter coats on faces of peds and in pores; about 2 percent gravel; neutral; gradual wavy boundary.

Btnz—18 to 28 inches; dark olive brown (2.5Y 3/3) fine sandy loam, olive brown (2.5Y 4/3) dry; moderate medium prismatic structure parting to moderate medium angular blocky; very hard and firm; slightly sticky and slightly plastic; few very fine and fine roots; few distinct clay films and organic matter coats on faces of peds; about 8 percent gravel; common fine flecks of salt; few fine masses of lime; slightly alkaline; gradual wavy boundary.

2Bkz—28 to 34 inches; light olive brown (2.5Y 5/3) loam, light yellowish brown (2.5Y 6/3) dry; moderate medium subangular blocky structure; hard and firm; slightly sticky and slightly plastic; few very fine roots; about 10 percent gravel; common fine flecks of salt; few fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

2Bk—34 to 47 inches; olive brown (2.5Y 4/3) loam, light yellowish brown (2.5Y 6/3) dry; common medium distinct olive yellow (2.5Y 6/6) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; about 10 percent gravel; few fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

2C—47 to 60 inches; olive brown (2.5Y 4/3) loam, light yellowish brown (2.5Y 6/3) dry; common medium distinct dark red (2.5YR 3/6) and pale yellow (2.5Y 7/4) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; about 12 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 30 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

E horizon:
Value: 2 to 4, 4 or 5 dry
Chroma: 1 or 2

Btn horizon:
Value: 3 or 4, 4 or 5 dry

2Bk horizon:
Value: 5 or 6 dry
Chroma: 2 or 3

2C horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Lindaas Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent Material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Typic Argiaquolls

Typical pedon: (Outside Griggs County) Lindaas silty clay loam, 1,745 feet west and 290 feet north of the southeast corner of sec. 4, T. 144 N., R. 49 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to moderate fine granular; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; common pores; neutral; abrupt smooth boundary.

A—7 to 15 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to moderate medium platy; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; common pores; neutral; clear wavy boundary.

Bt—15 to 27 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; hard and firm; very sticky and very plastic; few fine roots throughout; common pores; organic stains and clay films on faces of prisms and pores; slightly alkaline; clear irregular boundary.

Bk—27 to 37 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; few fine distinct very dark gray (10YR 3/1) and few fine distinct yellowish brown (10YR 5/4) redoximorphic concentrations; weak coarse prismatic structure; slightly hard and friable; moderately sticky and moderately plastic; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg—37 to 60 inches; light olive gray (5Y 6/2) silt loam, light gray (5Y 7/2) dry; few fine distinct very dark gray (10YR 3/1) and few fine distinct strong brown (7.5YR 5/6) redoximorphic concentrations; weak very coarse prismatic structure parting to weak medium platy; slightly hard and friable; slightly sticky and slightly plastic; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: Greater than 16 inches
Depth to lime: 18 to 35 inches
Notes: Clayey material is below a depth of 40 inches in some pedons.

A horizon:
Texture: silt loam, clay loam, or silty clay loam

Bt horizon:
Texture: silty clay or clay

Bk horizon:
Texture: silt loam or silty clay loam

Cg horizon:
Texture: silt loam, clay loam, or silty clay loam

Ludden Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, frigid Typic Endoaquerts

Typical Pedon:
Ludden silty clay, 500 feet east and 150 feet south of the northwest corner of sec. 18, T. 148 N., R. 58 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very hard and firm; sticky and plastic; many very fine and fine roots; very slight effervescence; slightly alkaline; abrupt smooth boundary.

A—9 to 17 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium angular blocky structure; very hard and firm; sticky and very plastic; many very fine and fine roots; cracks to 1/2 inch wide extend throughout; slight effervescence; slightly alkaline; gradual smooth boundary.

Bw1—17 to 28 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; very hard and firm; sticky and very plastic; few very fine and fine roots; cracks filled with A material to 1/4 inch wide extend to a depth of about 24 inches; slight effervescence; slightly alkaline; gradual smooth boundary.

Bw2—28 to 35 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; very hard and firm; sticky and very plastic; few very fine and fine roots; few fine masses of lime; slight effervescence; slightly alkaline; gradual wavy boundary.

BCg—35 to 42 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; massive; very hard and firm; sticky and very plastic; common fine masses of lime; slight effervescence; slightly alkaline; gradual wavy boundary.

Cg—42 to 60 inches; dark gray (5Y 4/1) silty clay, light gray (5Y 6/1) dry; massive; very hard and firm; sticky and very plastic; common fine masses of lime; strong effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to 48 inches.
Salinity: The soil is saline in some map units.

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 1 or 2

Cg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5, 4 to 6 dry
Chroma: 1 or 2
Texture: silty clay, clay, or clay loam

Maddock Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Rapid
Landform: Outwash plains and moraines
Parent material: Eolian
Slope: 1 to 15 percent

Taxonomic class: Sandy, mixed Udorthentic Haploborolls

Typical Pedon
Maddock loamy fine sand, in an area of Maddock-Hecla loamy fine sands, 1 to 6 percent slopes, 2,385 feet west and 700 feet south of the northeast corner of sec. 22, T. 146 N., R. 58 W.

Ap—0 to 11 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak coarse granular structure; soft and very friable; nonsticky and nonplastic; many very fine and fine roots; neutral; abrupt smooth boundary.

Bw—11 to 21 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; common very fine and fine roots; neutral; gradual wavy boundary.

C1—21 to 53 inches; brown (10YR 5/3) loamy fine sand, very pale brown (10YR 7/3) dry; single grain; loose; nonsticky and nonplastic; slightly alkaline; gradual wavy boundary.

C2—53 to 60 inches; grayish brown (10YR 5/2) fine sand, light gray (10YR 7/2) dry; single grain; loose; nonsticky and nonplastic; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 16 inches
Notes: Some pedons have a fine sand or loamy fine sand AC horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 3 or 4, 5 or 6 dry
Chroma: 2 or 3
Texture: fine sand or loamy fine sand

C horizon:
Value: 4 or 5, 6 or 7 dry
Chroma: 2 to 4

Manfred Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Natraquolls

Typical pedon: (Outside Griggs County)
Manfred silty clay loam, 2,100 feet east and 50 feet north of the southwest corner of sec. 17, T. 156 N., R. 58 W.

A—0 to 10 inches; black (5Y 2/1) silty clay loam, very dark gray (N 3/0) dry; moderate fine and medium subangular blocky structure; very hard and firm; moderately sticky and moderately plastic; common roots throughout; slight effervescence throughout (HCl, unspecified); moderately alkaline; abrupt irregular boundary.

Btng—10 to 13 inches; dark olive gray (5Y 3/2) silty clay loam, dark gray (5Y 4/1) dry; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; strong fine angular blocky structure; very hard and firm; very sticky and very plastic; clay films on faces of peds; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear irregular boundary.

Bkg—13 to 23 inches; olive gray (5Y 5/2) sandy clay loam, light olive gray (5Y 6/2) dry; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium angular blocky structure parting to moderate fine granular; very hard and friable; moderately sticky and moderately plastic; few iron and manganese concretions; about 5 percent by volume fine gravel; violent effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

BCg—23 to 30 inches; olive gray (5Y 5/2) sandy clay loam, light olive gray (5Y 6/2) dry; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium angular blocky structure parting to moderate fine granular; friable; 10 percent gravel; strong effervescence throughout (HCl, unspecified); few iron and manganese concretions; moderately alkaline; clear wavy boundary.

Cg1—30 to 48 inches; olive gray (5Y 5/2) clay loam, gray (5Y 6/1) dry; many fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; very hard and firm; moderately sticky and moderately plastic; strong effervescence throughout (HCl, unspecified); 5 percent gravel; moderately alkaline; gradual wavy boundary.

Cg2—48 to 60 inches; olive brown (2.5Y 4/4) clay loam, light yellowish brown (2.5Y 6/4) dry; common fine prominent gray (N 5/0) redoximorphic depletions; massive; very hard and firm; moderately sticky and moderately plastic; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Notes: Some pedons have an O horizon up to 4 inches thick on the surface. Some pedons have an E horizon. Some pedons have Byz or Bkz horizons.

A horizon:
Texture: loam, clay loam, silt loam, or silty clay loam

Btng horizon:
Texture: clay loam or silty clay loam

Bkg horizon:
Texture: clay loam, loam, sandy clay loam, silt loam, or silty clay loam

Cg horizon:
Texture: loam, sandy clay loam, clay loam, or silty clay loam

Marysland Series

Depth Class: Very deep
Drainage Class: Poorly and very poorly drained
Permeability: Moderate
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon:
Marysland loam, 150 feet east and 1,315 feet south of the northwest corner of sec. 31, T. 147 N., R. 60 W.

Ak—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine and medium granular structure; slightly hard and friable; slightly sticky and plastic; many very fine and fine roots; violent effervescence; moderately alkaline; clear wavy boundary.

Bkg—8 to 15 inches; dark gray (N 4/0) clay loam, gray (N 6/0) dry; weak medium and coarse subangular blocky structure; slightly hard and friable; sticky and plastic; many very fine and fine roots; about 3 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

Cg1—15 to 26 inches; olive gray (5Y 5/2) loam, light gray (5Y 7/2) dry; common medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 10 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

2Cg2—26 to 30 inches; olive gray (5Y 5/2) gravelly sandy loam, light gray (5Y 7/2) dry; many medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and nonplastic; about 30 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

2Cg3—30 to 42 inches; olive gray (5Y 5/2) gravelly loamy coarse sand, light gray (5Y 7/2) dry; many medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; about 30 percent gravel; slight effervescence; moderately alkaline; clear wavy boundary.

2Cg4—42 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; many medium prominent yellowish brown (10YR 5/4) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; about 25 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 30 inches
Depth to sand and gravel: 20 to 40 inches

Ak horizon:
Hue: 10YR, 2.5Y, or neutral
Value: 2 or 3
Chroma: 1 or less

Bkg horizon:
Hue: 2.5Y or neutral
Value: 3 or 4, 5 to 7 dry
Chroma: 2 or less

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 1 or 2
Notes: Some pedons do not have a Cg horizon.

2Cg horizon:
Value: 3 to 5
Chroma: 1 or 2
Notes: It has 20 to 70 percent shale in the 0.1 to 76 mm fraction. It averages 15 to 30 percent gravel.

Mekinock Series

Depth class: Moderately deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Till plains and valleys
Parent material: Glacial till and weathered shale
Slope: 6 to 15 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic Leptic Natriborolls

Typical pedon: (Outside Griggs County)
Mekinock loam, 875 feet east and 200 feet south of the northwest corner of sec. 6, T. 163 N., R. 57 W.

E—0 to 2 inches; very dark gray (10YR 3/1) loam, gray (10YR 6/1) dry; moderate thin platy structure; slightly hard and friable; slightly sticky and slightly plastic; common fine and medium roots throughout; moderately acid; abrupt smooth boundary.

Btn—2 to 11 inches; very dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; strong coarse columnar structure parting to strong medium angular blocky; extremely hard and very firm; very sticky and very plastic; few fine roots between peds; many distinct clay films on faces of peds and light gray (10YR 7/2) silt coats on tops of columns; moderately alkaline; clear smooth boundary.

Btnyz—11 to 16 inches; dark grayish brown (2.5Y 3/2) clay, dark grayish brown (2.5Y 4/2) dry; strong coarse prismatic structure parting to strong fine and medium angular blocky; very hard and very firm; very sticky and very plastic; few very fine roots between peds; common distinct clay films on faces of peds; common fine masses of salt and gypsum; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

2C—16 to 25 inches; dark olive gray (5Y 3/2) clay, light olive gray (5Y 6/2) dry; massive; very hard and firm; very sticky and very plastic; few fine roots throughout; massive with few laminations characteristic of the shale bedrock; common fine masses of salt and gypsum; slightly alkaline; gradual wavy boundary.

2Cr—25 to 60 inches; dark gray (5Y 4/1) weathered bedrock, gray (5Y 6/1) dry; common prominent dark reddish brown (5YR 3/4) concretions.

Range in Characteristics

Depth to gypsum or other salts: 7 to 16 inches.
Depth to bedrock: 20 to 40 inches
Notes: Some pedons have an A horizon. Some pedons have a Byz or BC horizon.

E horizon:
Texture: loam or clay loam

Btn horizon:
Texture: clay, silty clay, or clay loam

2C horizon:
Notes: It has up to 15 percent shale fragments.

2Cr horizon:
Notes: It consists of weathered shale bedrock.

Nutley Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 25 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, frigid Chromic Hapluderts

Typical pedon: (Outside Griggs County)
Nutley silty clay, 360 feet south and 250 feet east of the northwest corner of sec. 8, T. 121 N., R. 58 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine granular structure; slightly hard and friable; moderately sticky and moderately plastic; slight effervescence throughout (HCl, unspecified); moderately alkaline; abrupt smooth boundary.

Bss—7 to 20 inches; dark grayish brown (2.5Y 4/2) clay, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to moderate very fine and fine angular blocky; hard and firm; moderately sticky and moderately plastic; few intersecting slickensides; slight effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Css—20 to 48 inches; olive (5Y 5/3) clay, pale yellow (5Y 7/3) dry; common fine prominent yellowish red (5YR 4/6) redoximorphic concentrations and common fine distinct gray (5Y 5/1) redoximorphic depletions; weak fine angular blocky structure; very hard and firm; very sticky and moderately plastic; fine tongues of dark gray (10YR 4/1) and black (10YR 2/1); few intersecting slickensides; strong effervescence throughout (HCl, unspecified); moderately alkaline; diffuse wavy boundary.

C—48 to 60 inches; olive (5Y 5/3) clay, pale yellow (5Y 7/3) dry; many medium prominent yellowish red (5YR 4/6) redoximorphic concentrations and many medium distinct gray (5Y 5/1) redoximorphic depletions; weak fine and medium angular blocky structure; very hard and firm; very sticky and moderately plastic; strong effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to l6 inches
Depth to lime: 0 to 10 inches
10 to 40 inch particle-size control section: silty clay, silty clay loam, or clay
Notes: When the soil is dry, cracks 1/2 to 2 inches wide and several feet long extend downward through the B horizon. Some pedons have a BC or Bk horizon.

Ap horizon:
Texture: silty clay loam, silty clay, clay, or clay loam

Bss horizon:
Texture: clay, silty clay, or silty clay loam

C horizon:
Texture: clay, silty clay, or silty clay loam
Notes: It has gypsum in some pedons.

Ojata Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are highly calcareous and saline.

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical pedon: (Outside Griggs County)
Ojata silty clay loam, 1,000 feet east and 200 feet north of the southwest corner of sec. 24, T. 152 N., R. 51 W.

Apz—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak very fine subangular blocky structure; hard and friable; moderately sticky and moderately plastic; few fine roots throughout; few fine salt crystals; strong effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

Bkz—8 to 20 inches; gray (5Y 6/1) silt loam, light gray (5Y 7/1) dry; many fine and medium distinct dark gray (5Y 4/1) redoximorphic concentrations; weak fine subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few very fine roots throughout; cracks filled with A material extend to 18 inches; few fine salt crystals; violent effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

C1—20 to 32 inches; dark grayish brown (2.5Y 4/2) stratified silt loam, light yellowish brown (2.5Y 6/4) dry; common fine and medium distinct gray (5Y 5/1) redoximorphic depletions and common fine and medium distinct yellowish brown (10YR 5/6) redoximorphic concentrations; weak fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few fine roots throughout; slight effervescence throughout (HCl, unspecified); strongly alkaline; gradual wavy boundary.

C2—32 to 47 inches; dark grayish brown (2.5Y 4/2) stratified silt loam, pale yellow (2.5Y 7/4) dry; common fine and medium distinct gray (2.5Y 6/1) redoximorphic depletions and few fine distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; weak fine subangular blocky structure; soft and friable; slightly sticky and slightly plastic; slight effervescence throughout (HCl, unspecified); strongly alkaline; gradual wavy boundary.

C3—47 to 60 inches; dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) silt loam, pale yellow (2.5Y 7/4) and light yellowish brown (2.5Y 6/4) dry; common fine and medium distinct gray (5Y 5/1) redoximorphic depletions; weak fine subangular blocky structure; soft and friable; slightly sticky and slightly plastic; common medium dark reddish brown (5YR 3/4) (iron-manganese) concretions; common large masses of gypsum crystals; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches.
Notes: The mollic epipedon has an electrical conductivity of more than 16 mmhos/cm. Some pedons have an ABk or ABkz horizon. Some pedons have a Bky horizon. Some pedons have stratified coarser or finer glaciolacustrine deposits or glacial till below a depth of 40 inches.

Apz horizon:
Texture: silt loam, silty clay loam, loam, or clay loam

Bkz horizon:
Texture: silt loam or silty clay loam

C horizon:
Texture: silt loam or silty clay loam
Notes: It has salt accumulations in some pedons.

Overly Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 9 percent

Taxonomic class: Fine-silty, mixed, superactive Pachic Udic Haploborolls

Typical pedon: (Outside Griggs County)
Overly silty clay loam, 300 feet east and 150 feet south of the northwest corner of sec. 18, T. 155 N., R. 53 W.

Ap—0 to 5 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; hard and friable; slightly sticky and slightly plastic; common fine roots throughout; many fine pores; neutral; abrupt smooth boundary.

A—5 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium and coarse angular blocky structure parting to moderate fine subangular blocky; hard and friable; moderately sticky and slightly plastic; common roots throughout; many fine pores; neutral; clear wavy boundary.

Bw—10 to 17 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; very hard and firm; moderately sticky and moderately plastic; few roots; common fine pores; clay films on faces of peds; segregated lime in a few pores and root channels in the lower part; slightly alkaline; clear wavy boundary.

Bk1—17 to 20 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; few fine faint brown (10YR 4/3) redoximorphic depletions; moderate fine subangular blocky structure; hard and friable; moderately sticky and slightly plastic; few fine roots throughout; many fine pores; strong effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk2—20 to 28 inches; light olive brown (2.5Y 5/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; few faint yellowish brown (10YR 5/4) redoximorphic concentrations; moderate fine and medium subangular blocky structure; hard and friable; moderately sticky and slightly plastic; few fine roots throughout; common fine pores; strong effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk3—28 to 38 inches; olive brown (2.5Y 4/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; few fine light gray (5Y 7/1) redoximorphic depletions and few fine light yellowish brown (10YR 6/4) redoximorphic concentrations; moderate very fine subangular blocky structure; hard and friable; moderately sticky and slightly plastic; few roots throughout; common fine pores; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

C—38 to 60 inches; light yellowish brown (2.5Y 6/4) dry, pale olive (5Y 6/3) dry, gray (5Y 6/1) dry, and yellowish brown (10YR 5/6) dry silt loam and silty clay loam; very hard and firm; moderately sticky and moderately plastic; laminated; gray (5Y 6/1) redoximorphic depletions and yellowish brown (10YR 5/6) dry prominent redoximorphic concentrations in the lower part; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 40 inches
10 to 40 inch particle-size control section: silty clay loam, silt loam, or clay loam
Notes: Some pedons have BC or BCk horizons. Strata of sand or clay are below a depth of 40 inches in some pedons.

A horizon:
Texture: silty clay loam, silt loam, clay loam, loam, or silty clay

Bw horizon:
Texture: silty clay loam or silt loam

Bk horizon:
Texture: silty clay loam or silt loam

C horizon:
Texture: silty clay loam, clay loam, silt loam, or silty clay

Parnell Series

Depth Class: Very deep
Drainage Class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Vertic Argiaquolls

Typical Pedon:
Parnell silty clay loam, 150 feet west and 955 feet north of the southeast corner of sec. 14, T. 144 N., R. 59 W.

A—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; neutral; clear wavy boundary.

Bt1—9 to 40 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard and firm; sticky and plastic; common very fine and fine roots; common faint clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—40 to 49 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; very hard and firm; sticky and plastic; few fine roots; few faint clay films on faces of peds; neutral; gradual wavy boundary.

Cg—49 to 60 inches; gray (5Y 5/1) silty clay loam, light gray (5Y 6/1) dry; common medium prominent olive yellow (2.5Y 6/8) redoximorphic concentrations; massive; very hard and firm; slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to 50 inches
Notes: Some pedons have an O horizon up to 4 inches thick. Some pedons have an E horizon up to 4 inches thick.

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or less

Bt horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 or 2
Texture: silty clay or silty clay loam

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 or 6 dry
Chroma: 1 or 2
Texture: silty clay, silty clay loam, or clay loam

Rauville Series

Depth Class: Very deep
Drainage Class: Very poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Typical Pedon:
Rauville silt loam, in an area of Lamoure and Rauville silt loams, 1,090 feet south and 160 feet west of the northeast corner of sec. 22, T. 146 N., R. 61 W.

A1—0 to 4 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine and common coarse roots; few fine snail shell fragments; slight effervescence; slightly alkaline; gradual wavy boundary.

A2—4 to 28 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine and few coarse roots; few fine snail shell fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

A3—28 to 41 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; common medium distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak coarse subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; few fine snail shell fragments; slight effervescence; moderately alkaline; gradual wavy boundary.

C—41 to 60 inches; black (10YR 2/1) loam, gray (10YR 5/1) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; few fine snail shell fragments; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to more than 60 inches
Notes: Some pedons have an O horizon up to 4 inches thick.

A horizon:
Hue: 10YR to 2.5Y, or neutral
Value: 3 to 5 dry
Chroma: 1 or less

C horizon:
Hue: 10YR or neutral
Value: 2 to 5, 5 to 7 dry
Chroma: 1 or less
Texture: silty clay loam, silt loam, or loam

Rosewood Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Sandy, mixed, frigid Typic Calciaquolls

Typical pedon: (Outside Griggs County) Rosewood fine sandy loam, 350 feet north and 1,000 feet west of the southeast corner of sec. 27, T. 153 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; very friable; few very fine roots throughout; 2 percent gravel; violent effervescence throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

Bkg1—8 to 11 inches; gray (5Y 5/1) fine sandy loam; common medium distinct light brownish gray (2.5Y 6/2) and common medium distinct dark grayish brown (2.5Y 4/2) redoximorphic concentrations; weak medium subangular blocky structure; very friable; few very fine roots throughout; 2 percent gravel; violent effervescence throughout (HCl, unspecified); moderately alkaline; abrupt wavy boundary.

Bkg2—11 to 18 inches; grayish brown (2.5Y 5/2) fine sandy loam; few medium distinct light yellowish brown (2.5Y 6/4) redoximorphic concentrations; weak fine and medium subangular blocky structure; very friable; 2 percent gravel; violent effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

Cg1—18 to 23 inches; light brownish gray (2.5Y 6/2) fine sand; single grain; loose; 5 percent gravel; strong effervescence throughout (HCl, unspecified); slightly alkaline; clear smooth boundary.

Cg2—23 to 47 inches; light gray (2.5Y 7/2) fine sand; common coarse prominent olive yellow (2.5Y 6/6) and yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; 2 percent gravel; strong effervescence throughout (HCl, unspecified); slightly alkaline; clear wavy boundary.

Cg3—47 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; common medium prominent yellowish brown (10YR 5/6) and many coarse prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; single grain; loose; 5 percent gravel; slight effervescence throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
10 to 40 inch particle-size control section: Contains less than 10 percent gravel
Depth to sandy material: Less than 20 inches
Notes: Strata up to 6 inches thick with up to 25 percent gravel occur in the lower sandy material in some pedons.

Ap horizon:
Texture: fine sandy loam, loamy fine sand, or sandy loam

Bkg horizon:
Texture: fine sandy loam, sandy loam, loamy fine sand, loamy sand, or fine sand

Cg horizon:
Texture: fine sand, sand, or coarse sand
Notes: It is loamy fine sand or loamy sand in the upper part in some pedons.

Ryan Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic, frigid Typic Natraquerts

Typical pedon: (Outside Griggs County)
Ryan silty clay, 1,810 feet south and 1,735 feet west of the northeast corner of sec. 36, T. 132 N., R. 60 W.

E—0 to 2 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak thin platy and angular blocky structure; very hard and firm; moderately sticky and moderately plastic; common fine roots throughout; moderately alkaline; abrupt smooth boundary.

Btn1—2 to 4 inches; black (10YR 2/1) silty clay, dark gray (5Y 4/1) dry; strong medium and coarse columnar structure parting to strong fine angular blocky; top of columns coated with gray (5Y 5/1) silt coatings; very hard and firm; very sticky and very plastic; few fine roots throughout; many faint clay films on faces of peds; strongly alkaline; clear smooth boundary.

Btn2—4 to 8 inches; black (10YR 2/1) silty clay, dark gray (5Y 4/1) dry; moderate medium and coarse prismatic structure parting to strong fine angular blocky; very hard and firm; very sticky and very plastic; common fine roots throughout; many faint clay films on faces of peds; slight effervescence throughout (HCl, unspecified); strongly alkaline; clear wavy boundary.

Bg1—8 to 22 inches; black (10YR 2/1) silty clay, dark gray (N 4/0) dry; weak coarse prismatic structure parting to moderate fine subangular blocky; very hard and firm; very sticky and very plastic; few fine roots throughout; few lime masses; common fine salt crystals; strong effervescence throughout (HCl, unspecified); strongly alkaline; gradual wavy boundary.

Bg2—22 to 36 inches; black (10YR 2/1) silty clay, dark gray (N 4/0) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard and firm; very sticky and very plastic; few lime masses; common fine salt crystals; strong effervescence throughout (HCl, unspecified); strongly alkaline; gradual wavy boundary.

Cg—36 to 60 inches; very dark gray (5Y 3/1) silty clay, gray (N 5/0) dry; massive; very hard and firm; very sticky and very plastic; common fine gypsum crystals; few fine lime masses; strong effervescence throughout (HCl, unspecified); strongly alkaline.

Range in Characteristics

Mollic epipedon thickness: 20 to 50 inches
Depth to lime: 0 to 10 inches
Notes: Where uncultivated, the combined thickness of the A and E horizons is less than 5 inches. Some pedons have a Btnz, Bk, or Bkz horizon. Coarser textured deposits are below a depth of 40 inches in some pedons.

E horizon:
Texture: loam, silt loam, silty clay loam, or silty clay

Btn horizon:
Texture: clay or silty clay

Bg and Cg horizons:
Texture: silty clay, clay, or silty clay loam

Serden Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and moraines
Parent material: Eolian
Slope: 1 to 15 percent

Taxonomic class: Mixed, frigid Typic Udipsamments

Typical pedon: (Outside Griggs County)
Serden loamy fine sand, 375 feet south and 65 feet west of the northeast corner of sec. 4, T. 135 N., R. 51 W.

A—0 to 3 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; moderate fine granular structure; very friable; nonsticky and nonplastic; common fine roots throughout; neutral; clear smooth boundary.

AC—3 to 8 inches; very dark brown (10YR 2/2) fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose; nonsticky and nonplastic; few fine roots throughout; neutral; clear smooth boundary.

C—8 to 60 inches; dark grayish brown (10YR 4/2) fine sand, grayish brown (10YR 5/2) dry; single grain; loose; nonsticky and nonplastic; few fine roots to 30 inches; neutral.

Range in Characteristics

Depth to lime: 36 to more than 60 inches

A horizon:
Texture: sand, loamy sand, loamy fine sand, or fine sand

C horizon:
Notes: The texture averages sand in some pedons.

Sinai Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Lake plains
Parent material: Colluvium
Slope: 0 to 9 percent

Taxonomic class: Fine, smectitic, frigid Typic Hapluderts

Typical pedon: (Outside Griggs County)
Sinai silty clay, 740 feet west and 310 feet south of the northeast corner of sec. 4, T. 124 N., R. 55 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard and friable; moderately sticky and moderately plastic; few fine roots throughout; slightly acid; abrupt smooth boundary.

A—7 to 12 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate medium granular; cracks 1/2 inch to 1 inch wide; very hard and firm; moderately sticky and moderately plastic; few fine roots throughout; slightly acid; clear smooth boundary.

Bss—12 to 23 inches; very dark grayish brown (10YR 3/2) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard and firm; very sticky and very plastic; few fine roots throughout; surface of peds are shiny; tongues of very dark gray (10YR 3/1) moist, 1/8 inch to over 2 inches thick are common; few intersecting slickensides; neutral; clear wavy boundary.

Bkss1—23 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard and firm; moderately sticky and moderately plastic; tongues of very dark gray (10YR 3/1) moist, 1/8 inch to over 2 inches thick; few intersecting slickensides; strong effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary;

Bkss2—33 to 42 inches; dark grayish brown (2.5Y 4/2) silty clay, light gray (2.5Y 7/2) dry; few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; moderate medium prismatic structure; very hard and firm; moderately sticky and moderately plastic; few intersecting slickensides; common fine and medium accumulations of lime; strong effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C—42 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; few coarse prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; very hard and firm; moderately sticky and moderately plastic; few fine nests of gypsum; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 25 inches
Depth to lime: 17 to 35 inches
Notes: When the soil is dry, cracks 1/8 inch to 2 inches wide and several feet long extend downward through the B horizon.

A horizon:
Texture: silty clay, silty clay loam, or clay

Bss and Bkss horizons:
Texture: silty clay or clay

C horizon:
Texture: silty clay or clay
Notes: It is stratified with layers of silty clay loam, clay loam, and silt loam in some pedons.

Sioux Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Landform: Till plains
Parent material: Glaciofluvial deposits
Slope: 0 to 35 percent

Taxonomic class: Sandy-skeletal, mixed Udorthentic Haploborolls

Typical Pedon: (Outside Griggs County)
Sioux loam, 1,200 feet west and 2,375 feet south of the northeast corner of sec. 33, T. 126 N., R. 53 W.

A—0 to 5 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak fine and medium granular structure; soft and very friable; many fine roots throughout; slightly alkaline; clear smooth boundary.

AC—5 to 8 inches; very dark grayish brown (10YR 3/2), broken face, gravelly loam, grayish brown (10YR 5/2), broken face, dry; weak coarse subangular blocky structure; soft and very friable; common fine roots throughout; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C—8 to 60 inches; brown (10YR 5/3) and dark yellowish brown (10YR 4/4) very gravelly sand, light brownish gray (10YR 6/2) and pale brown (10YR 6/3) dry; single grain; loose; masses of lime on undersides of pebbles in the upper part; slight effervescence throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Depth to lime: 3 to 10 inches
10 to 40 inch particle-size control section: contains more than 35 percent gravel
Depth to sand and gravel: 6 to 14 inches
Notes: Some pedons have Bk horizons.

Southam Series

Depth Class: Very deep
Drainage Class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls

Typical Pedon:
Southam silty clay loam, 225 feet east and 515 feet south of the northwest corner of sec. 18, T. 144 N., R. 61 W.

Oe—0 to 3 inches; black (N 2/0), very dark gray (10YR 3/1) dry; partially decomposed stems, leaves, and roots; many very fine and fine, common medium, and few coarse roots; abrupt smooth boundary.

Ag1—3 to 13 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; weak fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine, and few medium and coarse roots; common fine and medium snail shell fragments; slight effervescence; slightly alkaline; clear wavy boundary.

Ag2—13 to 20 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; massive; hard and firm; very sticky and very plastic; many very fine and fine roots; common fine and medium snail shell fragments; few fine masses of lime; slight effervescence; moderately alkaline; gradual wavy boundary.

Ag3—20 to 41 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; massive; very hard and very firm; very sticky and very plastic; few very fine and fine roots; common fine and medium snail shell fragments; few medium masses of lime; strong effervescence; slightly alkaline; gradual wavy boundary.

Ag4—41 to 51 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; massive; very hard and very firm; very sticky and very plastic; common fine masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg—51 to 60 inches; olive gray (5Y 4/2) silty clay loam, light olive gray (5Y 6/2) dry; many medium prominent dark brown (7.5YR 4/4) redoximorphic concentrations; massive; very hard and firm; very sticky and very plastic; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to 60 inches

Oe horizon:
Notes: It ranges from 1 to 5 inches thick.

Ag horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 or 4 dry
Chroma: 2 or less

Cg horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 to 7, 4 to 8 dry
Chroma: 2 or less
Notes: Some pedons do not have a Cg horizon.

Stirum Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderately slow in the upper part and rapid in the lower part
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Coarse-loamy, mixed, superactive frigid Typic Natraquolls

Typical Pedon:
Stirum fine sandy loam, in an area of Stirum-Arveson, saline, fine sandy loams, 2,060 feet north and 1,475 feet west of the southeast corner of sec. 14, T. 146 N., R. 60 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; moderately alkaline; abrupt smooth boundary.

Btkng1—8 to 13 inches; gray (5Y 5/1) fine sandy loam, light gray (5Y 7/1) dry; strong coarse prismatic structure parting to moderate medium angular blocky; very hard and friable; slightly sticky and slightly plastic; common very fine and fine roots on ped faces; common distinct clay films and organic matter coats on faces of peds and in pores; violent effervescence; very strongly alkaline; clear wavy boundary.

Btkng2—13 to 23 inches; gray (5Y 5/1) fine sandy loam, light gray (5Y 7/1) dry; moderate medium prismatic structure parting to weak medium subangular blocky; very hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; few distinct clay films and organic matter coats on faces of peds and in pores; few fine masses of lime; violent effervescence; very strongly alkaline; gradual irregular boundary.

Bkg1—23 to 32 inches; gray (5Y 6/1) fine sandy loam, light gray (5Y 7/1) dry; common fine prominent light olive brown (2.5Y 5/3) redoximorphic concentrations; massive; hard and very friable; slightly sticky and nonplastic; strong effervescence; very strongly alkaline; clear smooth boundary.

Bkg2—32 to 43 inches; light olive gray (5Y 6/2) loamy fine sand, light gray (5Y 7/2) dry; few fine prominent dark brown (7.5YR 3/2) and (7.5YR 3/4) redoximorphic concentrations; single grain; slightly hard and loose; nonsticky and nonplastic; strong effervescence; very strongly alkaline; abrupt smooth boundary.

Cg1—43 to 47 inches; light olive gray (5Y 6/2) coarse sandy loam, light gray (5Y 7/2) dry; common medium prominent dark brown (7.5YR 3/2) and (7.5YR 3/4) redoximorphic concentrations; single grain; slightly hard and loose; nonsticky and nonplastic; about 8 percent gravel; slight effervescence; very strongly alkaline; clear smooth boundary.

Cg2—47 to 60 inches; olive gray (5Y 5/2) loamy sand, light gray (5Y 7/2) dry; common medium prominent dark brown (7.5YR 3/2) and (7.5YR 3/4) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; slight effervescence; strongly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Btkng horizon:
Value: 3 to 5, 4 to 7 dry
Chroma: 1 or 2

Cg horizon
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4

Svea Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 9 percent

Taxonomic class: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon:
Svea loam, in an area of Barnes-Svea loams, 3 to 6 percent slopes, 2,310 feet west and 2,590 feet south of the northeast corner of sec. 12, T. 144 N., R. 58 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; about 1 percent gravel; neutral; clear smooth boundary.

A—10 to 18 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; many very fine and fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bw1—18 to 24 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 4 percent gravel; neutral; clear wavy boundary.

Bw2—24 to 28 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; about 4 percent gravel; neutral; clear wavy boundary.

Bk—28 to 36 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; common medium masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to more than 26 inches
Notes: Some pedons have a BC or BCk horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 4
Texture: loam or clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Value: 4 or 5, 5 or 6 dry
Chroma: 2 to 4

Swenoda Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderately rapid in the upper part and moderately slow in the lower part
Landform: Till plains
Parent material: Glaciofluvial deposits over glacial till
Slope: 0 to 9 percent

Taxonomic class: Coarse-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon:
Swenoda fine sandy loam, 0 to 3 percent slopes, 135 feet west and 1,750 feet south of the northeast corner of sec. 34, T. 147 N., R. 58 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; neutral; clear smooth boundary.

A—9 to 13 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; neutral; clear wavy boundary.

Bw1—13 to 19 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and very friable; slightly sticky and slightly plastic; common very fine and fine roots; slightly alkaline; clear wavy boundary.

Bw2—19 to 29 inches; dark yellowish brown (10YR 4/4) fine sandy loam, light yellowish brown (10YR 6/4) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and very friable; slightly sticky and slightly plastic; few very fine and fine roots; slightly alkaline; gradual wavy boundary.

Bw3—29 to 33 inches; dark brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; few very fine and fine roots; about 2 percent gravel; slightly alkaline; clear wavy boundary.

2Bk—33 to 39 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; weak coarse subangular blocky structure; soft and friable; slightly sticky and slightly plastic; about 4 percent gravel; violent effervescence; moderately alkaline; clear wavy boundary.

2C—39 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct light brownish gray (2.5Y 6/2) redoximorphic depletions and light olive brown (2.5Y 5/6) redoximorphic concretions; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches

Depth to glacial till: 20 to 40 inches
Notes: Some pedons have a 2Bw horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry

2Bk horizon:
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 4
Notes: Some pedons do not have a 2Bk horizon.

2C horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5, 6 or 7 dry
Chroma: 2 to 4

Tiffany Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls

Typical pedon: (Outside Griggs County)
Tiffany fine sandy loam, 550 feet south and 330 feet east of the northwest corner of sec. 23, T. 151 N., R. 54 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine granular; slightly hard and very friable; slightly sticky and nonplastic; common very fine roots throughout; many fine pores; slightly acid; abrupt smooth boundary.

A—10 to 15 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; many fine distinct brown (10YR 4/3) redoximorphic concentrations; moderate medium subangular blocky structure; slightly hard and very friable; slightly sticky and slightly plastic; few very fine roots throughout; common medium pores; clear wavy boundary.

AC—15 to 23 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; many medium prominent dark yellowish brown

(10YR 4/4) redoximorphic concentrations; weak medium subangular blocky structure; slightly hard and very friable; slightly sticky and nonplastic; few very fine roots throughout; common fine pores; few fine iron-manganese concretions; clear wavy boundary.

C1—23 to 36 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/3) dry; many medium prominent strong brown (7.5YR 5/6) and few fine distinct dark gray (10YR 4/1) redoximorphic concentrations; weak medium subangular blocky structure parting to weak fine granular; slightly hard and very friable; slightly sticky and nonplastic; few very fine roots throughout; common fine pores; slight effervescence (HCl, unspecified); few fine black iron-manganese concretions; slight effervescence in lower part; clear wavy boundary;

C2—36 to 60 inches; light olive brown (2.5Y 5/4) and light brownish gray (2.5Y 6/2) stratified fine sandy loam, loamy fine sand, and loamy very fine sand, pale yellow (2.5Y 7/4) and light gray (2.5Y 7/2) dry; many fine and medium prominent red (2.5YR 5/6), yellowish brown (10YR 5/6), and very dark brown (10YR 2/2) redoximorphic concentrations and olive gray (5Y 5/2) redoximorphic depletions; massive; slightly hard and very friable; nonsticky and nonplastic; slight effervescence throughout (HCl, unspecified); few fine iron-manganese concretions.

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Depth to lime: 20 to more than 60 inches
10 to 40 inch particle-size control section: averages fine sandy loam to silt loam
Notes: Some pedons have a Bw or Bk horizon. Some pedons have loamy, silty, or clayey materials below a depth of 40 inches.

A horizon:
Texture: fine sandy loam, sandy loam, loam, very fine sandy loam, or silt loam

AC horizon:
Notes: The horizon has redoximorphic features and they increase in number and distinctness with depth.

Tonka Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium over glacial till
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Argiaquic Argialbolls

Typical Pedon:
Tonka silt loam, in an area of Hamerly-Tonka complex, 0 to 3 percent slopes, 600 feet west and 2,330 feet south of the northeast corner of sec. 32, T. 144 N., R. 61 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate coarse subangular blocky structure; hard and firm; slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; neutral; clear smooth boundary.

A—7 to 11 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; hard and firm; slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; neutral; clear wavy boundary.

E—11 to 17 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many fine distinct dark grayish brown (2.5Y 4/2) redoximorphic depletions; moderate thin platy structure; slightly hard and friable; slightly sticky and nonplastic; common very fine and fine and few medium roots; neutral; clear wavy boundary.

Bt—17 to 30 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; many fine distinct dark grayish brown (2.5Y 4/2) redoximorphic depletions; weak coarse prismatic structure parting to weak coarse angular blocky; very hard and very firm; very sticky and plastic; few very fine roots; many faint clay films on faces of peds; neutral; clear wavy boundary.

2BCg—30 to 40 inches; olive gray (5Y 5/2) clay loam, light olive gray (5Y 6/2) dry; many fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; weak coarse subangular blocky structure; hard and firm; slightly sticky and slightly plastic; about 4 percent gravel; slightly alkaline; gradual wavy boundary.

2Cg—40 to 60 inches; gray (5Y 5/1) loam, light gray (5Y 6/1) dry; many medium prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; about 4 percent gravel; very slight effervescence; slightly alkaline.

Range in Characteristics

Notes: Some pedons have a Bk horizon. Some pedons have a silt loam or silty clay loam Cg horizon.

A horizon:
Value: 2 or 3, 3 or 4 dry

E horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 or 2

Bt horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 1 or 2
Texture: silty clay loam, silty clay, clay, or clay loam

2BCg horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 1 or 2
Notes: Some pedons do not have a 2BCg horizon.

2Cg horizon:
Hue: 2.5Y or 5Y
Value: 5 or 6, 6 or 7 dry
Chroma: 1 or 2

Towner Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Rapid in the upper part and moderately slow in the lower part
Landform: Till plains
Parent material: Eolian over glacial till
Slope: 0 to 6 percent

Taxonomic class: Sandy over loamy, mixed, superactive Udorthentic Haploborolls

Typical Pedon:
Towner loamy fine sand, 0 to 6 percent slopes, 995 feet north and 675 feet west of the southeast corner of sec. 33, T. 147 N., R. 58 E.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and nonplastic; many fine and very fine roots; neutral; clear smooth boundary.

A—9 to 16 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and nonplastic; common fine and very fine roots; neutral; gradual wavy boundary.

Bw1—16 to 22 inches; very dark grayish brown (2.5Y 3/2) loamy fine sand, dark grayish brown (2.5Y 4/2) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine and very fine roots; slightly alkaline; clear wavy boundary.

Bw2—22 to 30 inches; olive brown (2.5Y 4/4) loamy fine sand, light olive brown (2.5Y 5/4) dry; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine and very fine roots; slightly alkaline; clear wavy boundary.

Bw3—30 to 35 inches; olive brown (2.5Y 4/4) loamy fine sand, light olive brown (2.5Y 5/4) dry; few fine prominent pale brown (10YR 6/3) redoximorphic concentrations and common fine faint light olive brown (2.5Y 5/4) redoximorphic depletions; weak coarse subangular blocky structure; soft and very friable; nonsticky and nonplastic; few fine and very fine roots; slightly alkaline; clear wavy boundary.

2Bk—35 to 46 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; common fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; hard and firm; slightly sticky and slightly plastic; about 5 percent gravel; many fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

2C—46 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; hard and firm; slightly sticky and slightly plastic; about 5 percent gravel; few fine masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Depth to glacial till: 20 to 40 inches

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 6 dry
Chroma: 1 to 4
Texture: loamy sand, loamy fine sand, or fine sand

2C horizon:
Texture: loam, clay loam, silty clay loam, or silt loam

Vallers Series

Depth Class: Very deep
Drainage Class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon:
Vallers loam, in an area of Vallers-Parnell complex, 1,000 feet south and 1,600 feet west of the northeast corner of sec. 21, T. 147 N., R. 59 W.

A1—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine and common medium roots; about 2 percent gravel; slight effervescence; slightly alkaline; gradual smooth boundary.

A2—6 to 12 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate coarse granular structure; slightly hard and friable; slightly sticky and slightly plastic; many fine and few medium roots; about 2 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Bkg—12 to 32 inches; gray (5Y 5/1) loam, light gray (5Y 7/1) dry; few fine prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; moderate medium and coarse subangular blocky structure; hard and friable; slightly sticky and slightly plastic; few fine roots; about 5 percent gravel; many medium and coarse masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg—32 to 60 inches; dark gray (5Y 4/1) loam, gray (5Y 6/1) dry; many medium prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; hard and friable; slightly sticky and slightly plastic; about 8 percent gravel; common medium masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Salinity: The soil is saline in some map units.
Notes: Some pedons have a BCkg horizon.

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 5 dry
Chroma: 1 or less

Bkg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6, 4 to 8 dry
Chroma: 1 or 2

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 to 7, 5 to 8 dry
Chroma: 1 to 3
Texture: loam or clay loam

Velva Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive Fluventic Haploborolls

Typical Pedon:
Velva fine sandy loam, 0 to 6 percent slopes, 1,600 feet west and 605 feet north of the southeast corner of sec. 23, T. 145 N., R. 60 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium granular structure; soft and very friable; slightly sticky and nonplastic; many very fine and fine roots; neutral; abrupt smooth boundary.

A—9 to 15 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine and fine roots; slight effervescence; slightly alkaline; clear wavy boundary.

C1—15 to 23 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots;

strong effervescence; moderately alkaline; gradual wavy boundary.

C2—23 to 41 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—41 to 55 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; few very fine and fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

Ab—55 to 60 inches; very dark grayish brown (2.5Y 3/2) sandy loam, dark grayish brown (2.5Y 4/2) dry; massive; slightly hard and friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 9 to 16 inches
Notes: Some pedons have an AC or a Bw horizon. Some pedons do not have an Ab horizon.

A horizon:
Value: 3 to 5 dry

C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 7 dry
Chroma: 2 to 4

Ab horizon:
Notes: Some pedons do not have an Ab horizon.

Walsh Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderately slow
Landform: Valleys
Parent material: Colluvium
Slope: 1 to 9 percent

Taxonomic class: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon:
Walsh silty clay loam, 1 to 6 percent slopes, 250 feet south and 210 feet west of the northeast corner of sec. 1, T. 146 N., R. 58 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; hard and friable; sticky and plastic; many very fine and few fine roots; about 6 percent shale channers; neutral; abrupt smooth boundary.

Bw1—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; very hard and firm; sticky and plastic; common very fine and few fine roots; about 5 percent shale channers; neutral; gradual wavy boundary.

Bw2—17 to 25 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; very hard and firm; sticky and plastic; common very fine and few fine roots; about 5 percent shale channers; neutral; gradual wavy boundary.

Bw3—25 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; weak medium prismatic structure parting to moderate coarse subangular blocky; very hard and firm; sticky and plastic; common very fine roots; about 5 percent shale channers; neutral; gradual wavy boundary.

C1—36 to 44 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 5/1) dry; moderate medium subangular blocky structure; very hard and firm; sticky and plastic; about 5 percent shale channers; slightly alkaline; gradual wavy boundary.

C2—44 to 60 inches; olive gray (5Y 4/2) silty clay loam, olive gray (5Y 5/2) dry; moderate medium subangular blocky structure; very hard and firm; sticky and plastic; about 5 percent shale channers; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 3 to 6 dry

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Texture: clay loam or silty clay loam

Walum Series

Depth Class: Very deep
Drainage Class: Moderately well drained
Permeability: Moderately rapid in the upper part and very rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 1 percent

Taxonomic class: Sandy, mixed Aquic Haploborolls

Typical Pedon:
Walum sandy loam, 2,290 feet east and 480 feet south of the northwest corner of sec. 27, T. 146 N., R. 60 W.

Ap—0 to 10 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; soft and friable; slightly sticky and nonplastic; common very fine and fine roots; about 5 percent gravel; neutral; clear smooth boundary.

Bw—10 to 16 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; soft and friable; slightly sticky and nonplastic; few very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

2Bw2—16 to 22 inches; very dark grayish brown (2.5Y 3/2) gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; common fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak coarse prismatic structure parting to weak coarse subangular blocky; soft and friable; slightly sticky and nonplastic; few very fine and fine roots; about 15 percent gravel; neutral; clear wavy boundary.

2Bk—22 to 30 inches; dark grayish brown (2.5Y 4/2) loamy sand, light brownish gray (2.5Y 6/2) dry; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations and faint light brownish gray (2.5Y 6/2) redoximorphic depletions; single grain; loose; nonsticky and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.

2C—30 to 60 inches; olive gray (5Y 4/2) gravelly coarse sand, olive gray (5Y 5/2) dry; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations and faint light brownish gray (2.5Y 6/2) redoximorphic depletions; single grain; loose; nonsticky and nonplastic; about 25 percent gravel; about 60 percent shale in the 0.1 to 76 mm fraction; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches.
Depth to sand and gravel: 14 to 25 inches
Notes: The sand and gravel material averages 20 to 85 percent shale in the 0.1 to 76 mm fraction. It has 20 to 50 percent gravel.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw and 2Bw horizons:
Value: 2 to 4
Chroma: 2 or 3

2Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4

C horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 1 or 2

Wyard Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Epiaquolls

Typical Pedon
Wyard loam, in an area of Hamerly-Wyard loams, 0 to 3 percent slopes, 265 feet north and 2,225 feet west of the southeast corner of sec. 31, T. 144 N., R. 61 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; common very fine roots; neutral; clear wavy boundary.

A—10 to 15 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

Bw—15 to 21 inches; very dark grayish brown (2.5Y 3/2) loam, dark grayish brown (2.5Y 4/2) dry; few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; few very fine roots; slightly alkaline; clear wavy boundary.

Bk—21 to 35 inches; light brownish gray (2.5Y 6/2) loam, white (2.5Y 8/2) dry; few fine distinct pale yellow (2.5Y 7/4) redoximorphic concentrations; weak coarse prismatic structure parting to moderate fine subangular blocky; slightly hard and friable; slightly sticky and slightly plastic; many fine masses of lime; violent effervescence; slightly alkaline; gradual wavy boundary.

C1—35 to 42 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; common fine masses of lime; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—42 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; slightly hard and friable; slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 24 inches

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 1 to 4

Bk horizon:
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

Wyndmere Series

Depth Class: Very deep
Drainage Class: Somewhat poorly drained
Permeability: Moderately rapid in the upper part and moderately slow in the lower part
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon:
Wyndmere fine sandy loam, loamy substratum, 0 to 3 percent slopes, 750 feet south and 1,220 feet west of the northeast corner of sec. 7, T. 148 N., R. 61 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse granular structure; slightly hard and very friable; slightly sticky and slightly plastic; many very fine and fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

ABk—9 to 14 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard and very friable; slightly sticky and slightly plastic; common very fine and fine roots; violent effervescence; moderately alkaline; clear wavy boundary.

Bk—14 to 28 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; moderate coarse prismatic structure parting to weak coarse subangular blocky; soft and very friable; slightly sticky and slightly plastic; common very fine and fine roots; common fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C1—28 to 37 inches; light olive brown (2.5Y 5/3) fine sandy loam, light yellowish brown (2.5Y 6/3) dry; many fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and faint grayish brown (2.5Y 5/2) redoximorphic depletions; massive; slightly hard and very friable; slightly sticky and slightly plastic; few very fine and fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—37 to 42 inches; light olive brown (2.5Y 5/4) loamy fine sand, light yellowish brown (2.5Y 6/4) dry; many fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and grayish brown (2.5Y 5/2) redoximorphic depletions; single grain; soft and very friable; nonsticky and nonplastic; few very fine roots: strong effervescence; moderately alkaline; clear wavy boundary.

2C3—42 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; many fine distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and many medium distinct grayish brown (2.5Y 5/2) redoximorphic depletions; massive; hard and friable; slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Value: 3 to 6, 4 to 8 dry
Chroma: 1 or 2

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4

2C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

Zell Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 6 to 25 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-silty, mixed, superactive Udic Calciborolls

Typical Pedon:
Zell silt loam, in an area of Eckman-Zell silt loams, 6 to 9 percent slopes, 200 feet north and 400 feet east of the southwest corner of sec. 13, T. 147 N., R. 58 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and slightly plastic; many fine and very fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk—8 to 20 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak coarse subangular blocky structure; soft and very friable; slightly sticky and slightly plastic; common fine and very fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—20 to 39 inches; olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; massive; soft and very friable; slightly sticky and slightly plastic; few fine and very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; massive; soft and very friable; slightly sticky and slightly plastic; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 2 to 4
Texture: silt loam or very fine sandy loam

C horizon:
Texture: silt loam, loam, or very fine sandy loam

Agronomy

About 86 percent of Griggs County is cultivated. In 1996, acreage planted of the principal close-grown crops were as follows: spring wheat, 130,000 acres; durum wheat, 1,500 acres; winter wheat, 700 acres; barley, 65,000 acres; oats, 2,400 acres; and flax, 1,600 acres. The main row crops were sunflowers, beans, corn, and potatoes. Sunflowers were planted on 23,900 acres, dry edible beans on 10,000 acres; soybeans on 3,000 acres; corn on 6,000 acres; and potatoes on 1,500 acres. Alfalfa and other hay crops were planted on 16,000 acres. Small acreages were planted to canola, mustard, lentils, millet, and safflower (Beard and Waldhaus, 1997).

Cropland limitations and general management practices needed for crops and hay and pasture are discussed in this section. Soil interpretive groups used by the Natural Resources Conservation Service for important farmlands, soil productivity indexes, land capability, pasture and hay, and windbreaks are explained. Soil quality and the management of saline and sodic soils are also discussed.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Cropland Limitations and Management

Management concerns affecting the use of detailed map units in the survey area for crops are shown in Table 6, “ Potential Cropland Limitations and Hazards.” The primary concerns in managing cropland are conserving moisture, controlling wind and water erosion, and maintaining or improving soil fertility and tilth.

Moisture at planting time is critical to the success of the crop during the growing season. In years where 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.

Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, trapping snow, and leaving crop residue on the surface also conserve moisture. 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.

Wind erosion may be a hazard on most of the soils in Griggs County. It is severe on the coarse textured and moderately coarse textured soils, such as Binford, Coe, Embden, Hecla, Maddock, Swenoda, and Walum. It is also a severe hazard on Arveson, Bearden, Buse, Colvin, Divide, Esmond, Fram, Hamerly, Lamoure, Marysland, Vallers, Wyndmere, and Zell soils. These soils have a relatively high content of lime and are susceptible to wind erosion in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure can break down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by wind erosion if they are not protected by residue.

Water erosion is a severe hazard on gently rolling and steeper soils, such as Barnes, Binford, Buse, Esmond, Kloten, and Zell. The hazard is greatest when the surface is bare.

Conservation practices that control both wind and water erosion are those that maintain a protective cover on the surface. An example is a conservation tillage system that keeps a protective amount of crop residue on the surface. Applications of approved herbicides can help to eliminate the need for summer fallow tillage. Cover crops are also effective in controlling both wind and water erosion. Field windbreaks, annual vegetative barriers, and stripcropping help to control wind erosion. 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.

Measures effective in maintaining or improving soil fertility and tilth include utilizing a nutrient management system that includes applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Wind and water erosion reduce productivity of 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 wind and water erosion. Controlling erosion helps prevent loss of organic matter and plant nutrients and helps maintain productivity. The level of fertility may be reduced even in areas where erosion is controlled. All soils used for crops generally respond well to a nutrient management system. Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the Cavour and Letcher soils which have a sodic subsoil and on the Ludden soils that have a silty clay surface layer. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter because it increases the susceptibility to erosion.

Additional limitations and management practices are as follows:

Alkalinity. This limitation reduces availability of selected nutrients and is associated with restricted seedling emergence and water infiltration. This limitation can be reduced with a nutrient management system and timely tillage operations. Tilling when the soil is neither too wet nor too dry helps to maintain tilth and prevent surface compaction. Maintaining crop residue on the surface and adding organic material to the plow layer help increase organic matter, prevent surface crusting, and maintain or improve tilth and fertility.

This limitation exists if the soil's pH is more than 7.8 at the surface.

Areas of rock outcrop. These areas are usually not accessible for cultivation and generally are unsuited to cultivated crops and hay and pasture. Farming around these areas may reduce the impact of this limitation on farming operations.

This limitation exists if "rock outcrop" is included in the name of the map unit.

Channels. These areas consist of meandering streams and oxbows. Most areas are isolated by streams or are irregularly shaped and often have standing water in the spring. These areas generally are unsuited to cultivated crops.

This limitation exists if "channeled" is included in the name of the map unit.

Dense layer. This limitation slows water infiltration and restricts root penetration. It can be managed by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, and deep tillage to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if the bulk density is greater than 1.7 in any soil layer.

Depth to rock. This limitation restricts rooting depth. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective on these areas. Some areas that are less than 20 inches to bedrock are not suitable for cultivated crops.

This limitation exists if soft or hard bedrock is within a depth of 40 inches.

Depth to sand and gravel. This limitation restricts rooting depth and may increase the potential for pesticide and nutrient leaching. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective in these areas. Some areas less than 12 inches to sand and gravel are not suitable for cultivated crops.

This limitation exists if there is more than 35 percent gravel in any soil layer at a depth of less than 40 inches.

Excessive saturated hydraulic conductivity. This limitation may cause deep leaching of nutrients and pesticides. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the saturated hydraulic conductivity of any soil layer is 6 inches per hour or more.

Flooding. This limitation can affect the timely seeding and survival of crops. In some situations this limitation can be managed by protecting the soil from flooding by diking or by building water retention structures and by planting vegetation that is adapted to flooded conditions. Some areas may be unsuitable for cultivated crops or protection measures may not be economical.

This limitation exists if the map unit is either occasionally flooded for long or very long periods or frequently flooded.

Gullies. This limitation makes cultivation difficult and hazardous. Generally, gullies are so deep that extensive reshaping is necessary for most uses. They generally are unsuited to cultivated crops, hay, and pasture.

This limitation exists if "gullied" is included in the name of the map unit.

High sodium content. This limitation restricts root, air, and water penetration in the subsoil. It may cause poor tilth and compaction. Tillage at the proper moisture content helps to maintain tilth. Tillage that loosens the dense, sodic subsoil or growing deep-rooted legumes, such as alfalfa and sweetclover, may improve soil physical conditions. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the sodium adsorption ratio (SAR) is more than 15 within a depth of 30 inches or if the soil is classified as an Aridic, Borollic, Leptic, Typic, Udic, or Vertic Natriboroll.

High water table. Wetness in undrained areas can delay tillage, seeding, and harvest operations in most years and prevent them in some years. Drained areas are suited to cultivated crops but locating suitable drainage outlets generally is difficult. Planting crops that are tolerant to wetness minimizes the impact of the high water table.

This limitation exists if the water table is within a depth of 36 inches.

Lime content. High lime content at the surface may cause increased wind erosion and surface crusting. It may also reduce availability of selected nutrients. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips to help control wind erosion. Field windbreaks planted on slopes greater than 8 percent may contribute to water erosion by concentrating spring runoff. Crops may respond well to a nutrient management system that includes additions of phosphate fertilizer.

This limitation exists if the soil is assigned to wind erodibility group 4L or averages more than 5 percent $CaCO_3$ equivalent in the upper 10 inches.

Limited available water capacity. This limitation reduces the capacity of the soil to retain moisture for plant use. A moisture conservation program can help manage these areas.

This limitation exists if the available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 8.5 inches or less or the electrical conductivity (EC) is more than 8 at less than 30 inches and the soil is moderately well drained or better.

Limited organic matter. This limitation may cause an increase in surface crusting and reduce the soil's natural fertility. Soil organic matter can be managed by utilizing a nutrient management system, incorporating crop residue or green manure crops into the soil, and using proper crop rotations.

This limitation exists if the content of organic matter is 1 percent or less in the surface layer.

Pesticide and nutrient leaching. This limitation increases the hazard of contaminating aquifers, springs, and local water tables. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the depth to the water table is less than 48 inches, depth to bedrock is less than 60 inches, or saturated hydraulic conductivity of any soil layer is 6 inches per hour or more.

Pesticide and nutrient runoff. This limitation increases the hazard of contaminating surface waters such as lakes, ponds, streams, and rivers. It can be managed with nutrient, pesticide, and conservation tillage systems which include leaving crop residue on the surface, following pesticide labels, and fertilizing based on soil nutrient testing. Limiting row crops on slopes of more than 8 percent reduces the rate of runoff of pesticides and nutrients. Runoff from upland areas can concentrate pesticides on ponded soils. Draining ponded areas may adversely affect the receiving surface waters.

This limitation exists if the soil is occasionally flooded or frequently flooded; is subject to ponding; is assigned to hydrologic group C or D and has a slope of more than 2 percent; is assigned to hydrologic group A and has a slope of more than 6 percent; or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

Ponding. This limitation can affect the timely seeding, harvesting, and survival of crops. Because of wetness and ponding, this soil generally is unsuited to cultivated crops, hay and pasture, and range.

This limitation exists if ponding occurs on the soil.

Poor tilth and compaction. This limitation restricts seedling emergence and water infiltration. It can be managed by timely tillage operations, maintaining crop residue on the surface, and adding organic material to the plow layer to increase soil organic matter. A cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, may improve root and water penetration.

This limitation exists if the upper 10 inches of the soil has more than 35 percent clay; has less than 1 percent organic matter; or has SAR of 5 or more.

Restricted saturated hydraulic conductivity. This limitation restricts root penetration and water saturated hydraulic conductivity. It can be managed with timely tillage operations and by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if saturated hydraulic conductivity is 0.06 inch per hour or less within a depth of 40 inches.

Root limiting. This limitation reduces the effectiveness of roots when the soil dries and increases moisture stress during extended dry periods. It can be managed with a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, and deep tillage to improve root and water penetration in the subsoil. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A moisture conservation system may be beneficial. For additional information about managing these soils see “Management of Saline and Sodic Soils.”

This limitation exists if the soil is classified as a Glossic or Glossic Udic Natriboroll.

Salt content. This limitation interferes with plant growth by restricting nutrient uptake and reducing available water. Using nutrient management and moisture conservation systems and growing salt-tolerant crops, such as barley, can help manage these areas. For additional information about managing these soils see “Management of Saline and Sodic Soils.”

This limitation exists if the soil has an EC of more than 4 in the surface layer or more than 8 within a depth of 30 inches.

Slick spots. The surface of these areas is non-vegetated and tends to puddle upon wetting. Slick spots are restrictive to air, water, and roots. These areas are best suited to range. Because of the dense and massive layers, they generally are unsuited to cultivated crops, hay, and pasture. For additional information about managing these soils see “Management of Saline and Sodic Soils.”

This limitation exists if “Slick spot” is included in the name of the map unit.

Slope. This limitation increases the potential for accelerated water erosion unless conservation farming practices are applied.

This limitation exists if the upper slope range of the map unit is more than 8 percent.

Soil slumping. This limitation indicates a potential for mass soil movement. These areas generally are unsuited to cultivated crops, hay, and pasture.

This limitation exists if the slope is more than 35 percent and the surface or subsoil has more than 35 percent clay; or if bedrock is at a depth of less than 60 inches and the subsoil contains more than 35 percent clay and slope is more than 25 percent; or if “slumped” is a modifier of any named component of the map unit.

Surface crusting. This limitation restricts seedling emergence and water infiltration. It can be managed with a system of conservation tillage that leaves crop residue on the surface and by incorporating organic material into the surface layer.

This limitation exists if the surface texture is silt, silt loam, silty clay loam, or very fine sandy loam and the surface layer organic matter content is less than 3 percent; or if the surface texture is loamy very fine sand, very fine sandy loam, fine sandy loam, sandy loam, sandy clay loam, loam, clay loam, silt, silt loam, or silty clay loam and the surface layer Calcium Carbonate Equivalent ($CaCO_3$) is equal to or greater than 1; or if the upper 10 inches has a SAR of 4 or more.

Surface rock fragments. This limitation adversely affects the use of mechanical equipment for cultivation and causes rapid wear of tillage equipment and difficult seedbed preparation. It cannot be easily overcome. These areas are generally unsuited to cultivated crops, hay, and pasture.

This limitation exists if the texture of the surface layer includes any rock fragment modifier except for gravelly or channery and “surface stones” are not already indicated as a limitation.

Surface stones. This limitation restricts normal cultivation practices. These areas are generally unsuited to cultivated crops, hay, and pasture. Economic removal of the surface stones generally is not feasible.

This limitation exists if the surface layer texture includes stony or bouldery modifiers or if “stony” or “bouldery” are included in the map unit name.

Water erosion. This limitation indicates an increased hazard of water erosion. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and grassed waterways in areas where runoff concentrates.

This limitation exists if the surface K factor (soil erodibility factor) multiplied by the upper slope percent is more than 2.

Wind erosion. This limitation indicates an increased hazard of wind erosion. This limitation can be managed by using a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, annual crop barriers, and a cropping sequence that includes grass-legume hay.

This limitation exists if the wind erodibility group is 1, 2, 3, 4, or 4L.

Erosion Factors

Soil erosion factors are used with other information to estimate the amount of soil lost through water and wind erosion. The procedure for predicting soil loss is useful in guiding and comparing the selection of soil and water conservation practices. The soil erodibility factors (K and Kf), the soil-loss tolerance factor (T), wind erodibility index (I) and wind erodibility groups (WEG) are described in “Physical Properties” in the “Soil Properties” section. Additional information about soil factors affecting wind and water erosion can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Prime Farmland and Other Important Farmland

In this section, prime farmland and other important farmland are defined. The map units in the survey area that are considered prime farmland, prime farmland where drained, additional farmland of statewide importance, or other land are listed on Table 7, “Map Unit Productivity Index and Farmland Designation.” Most map units have minor areas or inclusions that do not meet the listed farmland designation. More information about the criteria for prime farmland and other important farmland can be obtained at the local office of the Natural Resources Conservation Service.

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 land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pasture, forest land, or other land, but it is not urban, built-up land, or water areas. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce sustained high yields of crops in an economic manner.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible, not saturated with water for long periods, not frequently flooded during the growing season, or it is protected from flooding. The slope ranges mainly from 0 to 6 percent.

Soils with a seasonal high water table may qualify as prime farmland where this limitation is overcome by drainage measures. Onsite evaluation is necessary to determine the effectiveness of corrective measures.

A recent trend in land use in some parts of the nation has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive.

About 245,400 acres, or nearly 54 percent of the survey area, meets the requirements for prime farmland. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section “Detailed Map Units” and “Soil Series and Their Morphology.”

Additional Farmland of Statewide Importance

Some areas, other than areas of prime farmland, are of statewide importance in the production of food, feed, fiber, forage, and oilseed crops. The criteria used in defining and delineating these areas are determined by appropriate state and federal agencies. Generally, additional farmland of statewide importance includes areas that nearly meet the criteria for prime farmland and that economically produce high yields of crops when treated and managed with acceptable farming methods. Some areas can produce as high a yield as areas of prime farmland if conditions are favorable.

Other Land

Lands not meeting the criteria for Prime Farmland or Additional Farmland of Statewide Importance are placed into Other Land on Table 7, “Map Unit Productivity Index and Farmland Designation.”

This group includes Additional Farmland of Local Importance, Unique Farmland, and Other Land. These farmlands may have agricultural or nonagricultural uses.

Productivity Indexes and Crop Yield Estimates

Productivity indexes are relative ratings of the ability of a soil to produce a particular crop yield in comparison to other soils. They are useful in estimating long-term average crop yields, comparing the production capacity of soils, and in analyzing various economic impacts. Productivity indexes are shown in Table 7, "Map Unit Productivity Index and Farmland Designation." The average yields per acre that can be expected of the principal crops grown in the county under a high level of management are shown in Table 8, "Yields per Acre of Crops." Productivity indexes are given for drained conditions and, where applicable, undrained conditions.

Productivity indexes are based on soil properties important to crop production. Knowledgeable and experienced soil scientists, conservationists, and university researchers developed the indexes. They used results from field trials, demonstrations, and records, and experiences of producers (Ulmer and Patterson, 1988 a, b, c). In North Dakota, productivity indexes are based on long-term average spring wheat production. Similar and contrasting map unit inclusions are considered along with the named map unit components when the productivity index is calculated. The index ranges from 0, which indicates no long term economic production, to 100, which indicates the highest potential production. Productivity indexes and yields are based on the best available information, but they are difficult to determine for soils with variable properties such as salinity, sodicity, and degree of drainage.

In Griggs County, a productivity index of 100 was considered equal to a long term average yield of 40 bushels per acre of spring wheat. Multiplying the productivity index by 40 and dividing the product by 100 converts the index number to a figure representing the expected long-term average yield per acre. For example, map unit 156 Barnes-Svea loams, 3 to 6 percent slopes, has a productivity index of 83. This number multiplied by 40 and then divided by 100 converts to 33, which is the expected long-term average yield of spring wheat in bushels per acre for this map unit. In any given year, yields may be higher or lower than those indicated in the table because of variations in management, rainfall, and other production and climatic factors. 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. Productivity of a given soil compared with that of other soils, however, is not likely to change.

Management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include nutrient management systems, moisture conservation, and conservation tillage.

Crops other than those shown in the table 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 Natural Resources Conservation Service or the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. 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. Criteria used in grouping the soils do not take into account extensive and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland, or engineering purposes. The capability classification of each map unit is given in Table 9, "Interpretive Groupings Report."

In the land capability system, as described in "Land Capability Classification" (USDA-SCS, 1961), soils generally are grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. Capability classes are given for drained conditions and, where applicable, undrained conditions.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, such as wetness, that are impractical to remove and limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are designated by adding the letter, "E, W, S," or "C," to the class numeral, for example, 2E. The letter "E" shows the main hazard is the risk of erosion unless a close-growing plant cover is maintained; "W" shows that water in or on the soil interferes with plant growth or cultivation (in some soils wetness can be partly corrected by artificial drainage); "S" shows the soil is limited mainly because it is droughty, stony, or saline; and "C," used in only some parts of the United States, shows the chief limitation is climate that is very cold or very dry.

There are no subclasses in class I because soils of this class have few limitations. Class 5 contains only the subclasses indicated by "W, S," or "C" because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation. There are no subclasses in class 8.

Pasture and Hayland Interpretations

Pasture is land devoted to the production of adapted introduced or native forage plants for grazing by livestock. Hayland is land primarily used for the production of hay from long-term stands of adapted forage plants. Both pasture and hayland receive cultural treatments to enhance forage quality and yields. Because of the relatively short growing season, some producers have established cool-season tame pasture to complement the forage produced on rangeland and to extend the grazing season in the spring and fall.

Generally, large amounts of hay are needed to maintain livestock through the long, harsh winters. Hay was harvested on about 16,000 acres in Griggs County in 1996 (Beard and Waldhaus, 1997).

Proper pasture or hayland management is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing management on pastureland during the growing season helps plants maintain sufficient and vigorous top and root growth for sustained production. Brush and weed control is essential in many areas. Fertilizer increases production and enhances longevity of stands. Rotation grazing and renovation also are important management practices.

Soils are assigned to pasture and hayland groups according to their suitability for production of forage under intensive management. Soils in each suitability group are similar enough to be suited to the same species of grasses or legumes. They also have similar management concerns, productivity levels, and limitations and hazards.

Pasture and hayland suitability groups are given in Table 9, "Interpretive Groupings Report." They are given for drained conditions and, where applicable, undrained conditions. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information on adapted varieties and forage yields.

Pasture and Hayland Groups

The following paragraphs describe the Pasture and Hayland Groups in Major Land Resource Area (MLRA) 55B, which includes Griggs County. They specify the production potential under improved management and list representative adapted species for each group. The notations in parenthesis following the group name are suitability group reference symbols, often used in lieu of the name.

Clayey. (A4) These soils are deep and well, moderately well, and somewhat poorly drained. They are moderately fine and fine textured soils on uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, Russian wildrye, intermediate wheatgrass, western wheatgrass, green needlegrass, big bluestem, indiangrass, switchgrass, alfalfa, and sweetclover.

Clayey Subsoils. (F1) These soils are deep and moderately well and well drained. They are medium to fine textured soils on uplands. They have a claypan that is a moderate restriction to root growth. Otherwise, these soils have few limitations for the management and growth of adapted plants. Production potential is moderate to high. Suitable forage species include smooth bromegrass, Russian wildrye, intermediate wheatgrass, western wheatgrass, green needlegrass, switchgrass, alfalfa, and sweetclover.

Claypan. (G1) These soils are deep and somewhat poorly to well drained. They are moderately coarse to fine textured soils on uplands. The claypan is dense with very little root penetration. Typically, these soils are strongly alkaline in the claypan and below. These soils are saline below 16 inches. Production potential is low. Suitable forage species include western wheatgrass, thickspike wheatgrass, pubescent wheatgrass, slender wheatgrass, alfalfa, and sweetclover.

Limy Subirrigated. (A5) These soils are deep and somewhat poorly drained. They are moderately coarse to moderately fine textured, calcareous soils on uplands. They typically have a water table at about 1.5 to 3.5 feet during spring and early summer. The hazard of wind erosion is a concern during establishment. Production potential is high. Suitable forage species include big bluestem, indiangrass, switchgrass, little bluestem, smooth bromegrass, intermediate wheatgrass, pubescent wheatgrass, tall wheatgrass, slender wheatgrass, sweetclover, and birdsfoot trefoil.

Loamy and Silty. (A1) These soils are deep and mostly well and moderately well drained. They are medium textured soils on uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, switchgrass, indiangrass, big bluestem, sideoats grama, slender wheatgrass, alfalfa, and sweetclover.

Moderately Deep Silty. (F2) These soils are moderately deep and well drained. They are medium and moderately fine textured soils on uplands. Weathered siltstone or shale bedrock is at depths of 20 to 40 inches. Root penetration is limited by bedrock. Production potential is moderate to high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, green needlegrass, sideoats grama, switchgrass, big bluestem, alfalfa, and sweetclover.

Overflow and Run-On. (A3) These soils are deep and well to moderately well drained. They are moderately coarse to fine textured soils on flood plains or upland swales and in drainageways. Landscapes are typically plane or concave and receive run-on water from adjacent areas. Some soils are subject to flooding. Soils in this group have few limitations for adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, Russian wildrye, western wheatgrass, thickspike wheatgrass, big bluestem, indiangrass, switchgrass, alfalfa, and sweetclover.

Saline. (G4) These soils are deep and somewhat poorly and poorly drained. They are coarse to fine textured, saline soils on flats and in swales. The available water capacity is moderate because of salinity. Adapted plant species are those with moderate to high salt tolerance. Severely affected areas will need to be seeded and then mulched to reduce salt concentrations during seedling establishment. The better suited forage species include tall wheatgrass, slender wheatgrass, western wheatgrass, beardless wildrye, alkali sacaton, alsike clover, and sweetclover. Late fall, dormant seedings are recommended.

Sands. (A7) These soils are deep and moderately well to excessively drained. They are coarse textured soils on uplands and flood plains. Wind erosion is a severe hazard during establishment and renovation. Production potential is moderate to high. Species selection is limited for pasture and hayland. Suitable forage species include sand bluestem, prairie sandreed, little bluestem, intermediate wheatgrass, pubescent wheatgrass, and alfalfa.

Sands Soils. (H5) These soils are deep and moderately well to excessively drained. They are very sandy soils. The soils have a severe wind erosion hazard and are very droughty. They are low in organic matter and very fragile. Blowouts are common. These soils are not suited to pasture and hayland planting. Cultivated areas should be converted to rangeland.

Sandy. (A6) These soils are deep and well and moderately well drained. They are moderately coarse textured soils on uplands and flood plains. The hazard of wind erosion is a concern during establishment and renovation. Production potential is high. Species selection is somewhat limited. Suitable forage species include green needlegrass, slender wheatgrass, western wheatgrass, intermediate wheatgrass, pubescent wheatgrass, prairie sandreed, sand bluestem, switchgrass, alfalfa, and sweetclover.

Shallow. (H4) These soils are shallow and well to excessively drained. They are coarse to fine textured soils on uplands. They are less than 20 inches to weathered bedrock and have a severe water erosion hazard. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Shallow to Gravel. (B1) These soils are deep and well to excessively drained. They are medium to coarse textured soils on outwash plains. They typically have gravel and/or coarse sand at depths from 14 to 24 inches. These soils are droughty. Production potential is moderate. Only drought-tolerant species such as crested wheatgrass, sideoats grama, little bluestem, slender wheatgrass, intermediate wheatgrass, and alfalfa should be planted.

Sodic-Saline. (G3) These soils are deep and poorly drained. They are moderately coarse to fine textured claypan soils. These soils occur in drainageways, basins, and upland depressions. They typically are strongly alkaline and saline. Plant selection is limited because of the wetness, salinity, and alkalinity. Production potential ranges from low to moderate. Establishment is difficult, so mulching is recommended on more severely affected areas. Suitable forage species include tall wheatgrass, western wheatgrass, slender wheatgrass, Russian wildrye, beardless wildrye, switchgrass, alkali sacaton, alsike clover, and sweetclover. Late fall, dormant seedings are recommended.

Steeply Sloping. (H3) These soil areas are on slopes that average 25 percent or greater. Water erosion is a very severe hazard. These soils are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Stony. (H2) These are stony, very stony and extremely stony soils. They are not suited to pasture and hayland plantings. Cultivated areas that have had stone removal should be treated the same as the non-stony phase of the same soil in regard to pasture and hayland planting.

Strongly Saline. (H1) These are deep, poorly drained, moderately fine textured, strongly saline soils. High salinity makes it extremely difficult to establish grass stands. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Thin Claypan. (G2) These soils are deep and somewhat poorly to well drained. They are medium to fine textured thin claypan soils on uplands. The claypan is very dense with very little root penetration. Typically they are strongly alkaline in the claypan and below. They are saline within 16 inches of the surface. Production potential is very low to low. Species selection is extremely limited. The best suited forage species include western wheatgrass, slender wheatgrass, and beardless wildrye. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Thin Upland. (A2) These soils are deep and well and excessively drained. They are medium textured soils on uplands. They are on ridges, knobs, and other convex positions subject to runoff. The hazards of wind and water erosion are a concern during establishment. Production potential is moderate. Suitable forage species include smooth bromegrass, intermediate wheatgrass, crested wheatgrass, western wheatgrass, slender wheatgrass, little bluestem, sideoats grama, and alfalfa.

Very Shallow to Gravel. (B2) These soils are deep and well to excessively drained. They are medium to moderately coarse textured soils on outwash plains and scoria topped buttes. They typically have coarse sand and gravel or shattered porcelanite at depths of less than 14 inches. These soils are very droughty. Production potential is low and species selection is severely limited. Suitable species include thickspike wheatgrass, crested wheatgrass, little bluestem, and sideoats grama. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Wet. (C1) These soils are deep and poorly drained. They are coarse to fine textured soils on flood plains or low areas on till and lake plains. Wetness limits selection of locally adapted forage plants. Production potential is high to very high. Select plant species on the basis of flooding tolerance or inundation tolerance. Suitable species include reed canarygrass, creeping foxtail, big bluestem, switchgrass, indiangrass, meadow foxtail, and alsike clover.

Wetland. (H6) These soils are deep and very poorly drained. They are coarse to fine textured soils. They are usually too wet for cultivation and are not suited to pasture and hayland plantings unless drained. If drained, treat the same as the “Wet” pasture and hayland group.

Management of Saline and Sodic Soils

Saline and sodic soils make up about 6 percent of Griggs County. Saline soils make up about 4 percent of the area, or about 17,675 acres; sodic soils make up about 0.5 percent, or about 2,480 acres; and saline-sodic soils make up about 1.6 percent or 7,390 acres.

Saline soils have a high concentration of soluble salts, or salts that dissolve in water. Saline soils in Griggs County are phases of the Arveson, Bearden, Colvin, Hamerly, Ludden, and Vallers series.

Saline soils generally develop in areas of restricted drainage, such as those adjacent to sloughs and waterways. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced 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 (Seelig and Richardson, 1991).

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 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

Figure 8. An area of Ludden silty clay, saline. Bare areas and white salt crusts are comonly found in this map unit.

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 (fig. 8). Laboratory analysis or special field instruments are 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 produce 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. Continuous cropping is beneficial because it reduces evaporation and salt accumulation in the surface layer.

Sodic soils are characterized by a high content of exchangeable sodium which adheres to the clay particles in the soil (Seelig and Richardson, 1991). The sodic soils in Griggs County are phases of the Cathay, Cavour, Cresbard, Ferney, Lemert, Letcher, and Mekinock series. Locally, sodic soils are known as “black alkali,” “slick spots,” “pan spots,” or “gumbo.”

Sodic 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 sodic soils and the surrounding soils that have normal physical properties is only a few feet.

Sodic soils developed in areas of saline soils that contained large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, precipitation 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, sodic subsoil forms (fig. 9). The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. Examples are the Cavour and Lemert soils.

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

If plowed, sodic 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 sodic 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 sodicity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and stages of development. If the level of sodicity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, stage of crop growth, and soil moisture status. A measure of the effect of sodicity 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.

Figure 9. A dense, sodic subsoil that restricts the penetration of roots.

Variability of sodic soils can cause management problems. Soils that have a dense, sodic subsoil near the surface are better suited to grass than to small grain and sunflowers. Timely tillage is an important management need in areas of sodic soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soils puddle and crust. If the soils are tilled when too dry, tillage and seeding implements cannot easily penetrate the soils. Deep plowing and chemical amendments can help to reclaim sodic soils, but they may not be feasible. To be effective, deep tillage should reach below the sodic 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 sodic 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-sodic 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, sodic subsoil has formed. Examples are the Harriet and Stirum soils. The management needs and crop responses on these soils are a combination of those on saline soils and those on sodic soils.

Additional information about management or reclamation of saline and sodic soils is available from the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service (Franzen, et. al., 1994).

Soil Quality

Definition of Soil Quality

Soil quality is the ability of a soil to function within its surroundings, support plant and animal productivity, and maintain or enhance water and air quality. This is also referred to as soil health.

Functions of Soil

Soil is a living, dynamic resource. It has biological, chemical, and physical properties which are continually changing. Soil provides a physical, chemical, and biological environment for the exchange of water, air, and nutrients necessary for living organisms.

Soil controls the movement of rainfall or irrigation water on the land. Some of the water runs off the soil and directly enters surface water drainage systems. The remaining water either evaporates or infiltrates the soil. There it is stored and used for plant growth or percolates through the soil into the ground water. This control of water flow affects the movement of soluble materials, such as nitrate nitrogen and pesticides, through the environment.

Soil regulates biological activity and chemical exchanges. This affects nutrient cycling, plant growth, and decomposition of organic materials. Soil also acts as a filter to protect the quality of water and air. It provides mechanical support and a rooting environment for living organisms.

Soil quality can be viewed in two ways: In the first view, some soils are better suited than others to perform specific functions. For example, soils that are shallow to bedrock are poorly suited for supporting deep-rooted crops or trees. Soils high in sand and gravel content may have an inherently poor quality for filtering septic system wastes. Alternatively, these same soils may have a high quality or suitability for road and street construction. This view of soil quality is useful when comparing soils and is often used to evaluate the suitability of soils for specific uses.

The second view of soil quality relates to the dynamic nature of soils. Even though a soil may have a certain ability or level of quality for a specific activity, it may be functioning at a level below its inherent capability. This may be due to past disturbance or current management systems. For example, a farming system that does not protect the surface layer from erosion may result in soil erosion and loss of organic matter, nutrients, and other beneficial properties. In most cases, the eroded soil functions at less than its original potential for crop production. Its condition or health is considered impaired or lower in quality. In another example, a soil in a wetland, if drained or covered with sediment from nearby uplands, may not serve as effectively as a filter as it would in its natural condition.

Importance of Soil Quality to Landowners

Soil quality has a direct affect on plant growth and productivity for crop, range, hay, and woodland production. It affects how water moves into and through the soil. Maintaining or enhancing soil quality can help reduce the negative effects of soil erosion. Increasing soil quality can reduce the movement of nitrates and other chemicals to adjacent water bodies and ground water. Maintaining a high level of soil quality will ensure the soil resource is sustained for the future.

Many soils have undergone a degradation of their inherent quality through past agricultural operations. However, improved management practices, such as conservation tillage, implementing nutrient and moisture management systems, and establishment of riparian buffers or windbreaks can improve soil quality. As a rule, management practices that maintain a vegetative cover on the soil, return the maximum practical amount of residue, and minimize soil disturbance (tillage), will result in higher levels of soil quality.

Degradation of soil quality can have negative effects on the soil resource and costly offsite impacts. Soil erosion and the consequential deposition of sediment by wind or water are examples. Other negative effects of soil degradation include: compaction and loss of granular structure of surface soil layers, reduction of infiltration rates and organic matter levels, and formation of surface crusts. Degradation of soils can also lead to nutrient loss or imbalances, pesticide carryover, and reduced biological activity.

Soil Quality Indicators

The quality of most soils can be improved over time if managed properly. Key indicators of soil quality can be observed and monitored periodically to ensure the quality of the soil is maintained or enhanced.

Soil quality indicators are soil properties or processes that can be monitored to establish changes in the soil. Indicators can be categorized into four general groups: visual (sensory), physical, chemical, and biological.

Visual indicators may be obtained from observation or photographic interpretation. Exposure of subsoils, change in soil color, ephemeral gullies, ponding, plant response, and surface crusting are a few examples. Visual evidence can be a clear indication that soil quality is changing in either a negative or a positive way. The senses of feel and smell can also be used to evaluate certain soil properties.

Physical indicators are usually obtained by observation or field and laboratory analyses. They include topsoil thickness, bulk density, porosity, aggregate stability, texture, crusting, and compaction. These indicators reflect factors affecting root growth, soil biological activity, seedling emergence, and infiltration or movement of water and air within the soil.

Chemical indicators usually require sampling and field or laboratory analyses. They include measurements of pH, salinity, organic matter, phosphorus concentrations, cation-exchange capacity, and nutrients. The chemical condition of soil affects soil-plant relationships, water quality, buffering capacities, and mobility of nutrients and contaminants.

Biological indicators may be obtained by observation or measurement. They include measurements of micro- and macro-organisms and their activities. Respiration rates to detect microbial decomposition of organic matter and populations of bacteria, fungi, earthworms, nematodes, and mites can be used as biological indicators of soil quality.

Soil quality can be monitored through observation and/or measurement of key soil quality indicators. Soil quality score cards and a test kit (USDA-Soil Quality Institute, 1998) are available to assist in the assessment process. The monitoring program should include several indicators and take into consideration the time of year that sites are monitored, stage of crop growth, and location within the field where observations are made.

Monitoring soil quality should primarily be used to detect trends that are measurable over a 1- to 10-year period. Monitoring trends determines whether the soil is improving, degrading, or remaining steady under the current management system. This allows land managers to detect problems before undesired and possibly irreversible loss of soil quality occurs.

The local office of the Natural Resources Conservation Service, Soil Conservation District, or Cooperative Extension Service can help establish a plan for monitoring soil quality.

Woodland, Windbreaks and Environmental Plantings

Griggs County has approximately 3,400 acres of native woodland (Jakes and Smith, 1982). Most of this woodland is found around Red Willow Lake and in the valleys of the Sheyenne River and its tributaries. The wooded area around Red Willow Lake is mostly on areas of Emrick, Esmond, and Heimdal soils. The woodland on the side slopes of the river valley is primarily on areas of Edgeley, Esmond, and Kloten soils. The woodland on the bottomlands is mostly on areas of LaDelle soils.

The woodland types around Red Willow Lake are bur oak, green ash, and American elm. Boxelder is found in some areas. The understory species include redosier dogwood, common chokecherry, snowberry, and various willow species.

The forest type along the Sheyenne River is divided into two main types. The woodland on the side slopes is primarily bur oak and green ash. Green ash predominates on the lower slopes with bur oak dominating the upper slopes. Other trees and shrubs associated with these major tree species are common chokecherry and snowberry. The bottomland forest type is primarily bur oak, American elm, and green ash. Other less common species include boxelder and American basswood. The understory vegetation includes gooseberry and common chokecherry.

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 tree/shrub rows interspersed with cropland at specified intervals. Field windbreaks oriented perpendicular to the prevailing winds are the most efficient. Intervals depend on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on 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.

The following items should be considered before a planting is made: purpose of the planting, suitability of various species of trees and shrubs to the soils and climate, location and design of the windbreak, and selection of hardy seedlings. Planting stock should be from parent material originally from the Northern Great Plains or southern Canadian Prairie Provinces. If these items are not considered, a poor, unsuccessful windbreak may result.

Establishment of a windbreak or an environmental planting and growth of trees and shrubs also depends on suitable site preparation and adequate maintenance after the trees and shrubs are planted. Grasses and weeds should be eliminated before the trees and shrubs are planted and competing ground cover should be controlled for the life of the windbreak. Competition from sod-forming grasses will greatly harm, and sometimes kill, tree and shrub plantings. Some replanting may be necessary during the first two years after the trees and shrubs are planted.

Windbreaks are often planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil.

Windbreak suitability groups consist of soils in which the kinds and degrees of hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are similar. They are a guide for selecting species best suited for different kinds of soils. Windbreak suitability groups are shown for each soil in Table 9, “Interpretive Groupings Report.” They are given for drained conditions and, where applicable, undrained conditions.

Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

Table 10, “Windbreak Suitability Groups,” shows the height locally grown trees and shrubs are expected to reach in 20 years on various soils. Estimates in this table are based on measurements and observations 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 Natural Resources Conservation Service, the Cooperative Extension Service, or from a nursery.

The following paragraphs describe the windbreak suitability groups.

Group 1. These are very deep, well to somewhat poorly drained soils that receive beneficial moisture from favorable landscape positions, flooding, or runoff from adjacent land. They may also have a beneficial seasonally high water table during the spring. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species.

Group 1K. These are very deep, calcareous, well to somewhat poorly drained soils on low rises near wetlands that receive beneficial moisture from favorable landscape positions or have a beneficial seasonally high water table during the spring. High calcium carbonate content will have an effect on the selection of species on soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species. Wind erosion is a concern on these soils.

Group 2. Soils in this group are very deep, poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on the sandy and organic soils in this group.

Group 2H. Soils in this group are very deep, have an organic mat about 24 inches thick, are poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 2K. Soils in this group are very deep, calcareous, poorly or very poorly drained, on rims of potholes and broad flats that are excessively wet or ponded during the spring or overflow periods. Wetness, high calcium carbonate content, and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 3. Soils in this group are very deep, well drained, loamy textured soils with moderate and moderately slow saturated hydraulic conductivity on uplands. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4. Soils in this group are moderately deep to very deep, have loamy surface textures with clayey subsoils, have slow or very slow saturated hydraulic conductivity, and occur on uplands. High clay content has an effect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4C. Soils in this group are moderately deep to very deep, clayey throughout, have slow or very slow saturated hydraulic conductivity, and occur on uplands. High clay content has an effect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on the gently sloping to moderately steep areas.

Group 5. Soils in this group are very deep with loamy and sandy textures. This group typically includes soils that normally have adequate soil moisture. Competition from grass and weeds and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils.

Group 6D. Soils in this group are well drained, mostly loamy textured, and moderately deep over bedrock and other cemented layers that can severely restrict root growth. They have low or moderate available water capacity. Droughtiness will have an effect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 6G. Soils in this group are well drained, mostly loamy textured, and moderately deep over sand and gravel. The sand and gravel can restrict root growth and reduce available water capacity. Droughtiness will have an effect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 7. Soils in this group are very deep, excessively to moderately well drained, and sandy textured. They typically have low to very low available water capacity and do not normally have adequate moisture. Drought conditions and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils. Specialized site preparation and planting methods (vegetation between the rows is normally left undisturbed) are needed to establish trees and shrubs. Supplemental watering may be essential for successful establishment.

Group 8. Soils in this group are calcareous at or near the surface. They do not receive beneficial moisture from run-on, flooding, or seasonal high water tables. High calcium carbonate content and competition from grass and weeds are the principal concerns in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on gently sloping to moderately steep areas.

Group 9C. Soils in this group are clayey and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 9L. Soils in this group are loamy and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 9W. Soils in this group are affected by salinity and/or sodicity and have a high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 10. Soils in this group have one or more characteristics such as soil depth, texture, drainage, channeled phases, available water capacity, slope, or salt toxicity which severely limit planting, survival, or growth of trees and shrubs. Soils in this group are usually not recommended for farmstead and feedlot windbreaks, field windbreaks, and plantings for recreation and wildlife. However, onsite investigations may reveal tree and shrub plantings can be made with special treatments (hand planting, no till planting, scalp planting, specialized site preparation, drainage, or other specialized treatments). Selection of species must be tailored to soil conditions existing at each site.

All soils on moderately steep, steep, or very steep slopes (generally 15 percent or greater) and soils that are generally too wet, too shallow, or have other severely restrictive conditions fall into group 10. When an onsite investigation reveals a planting can be made on a soil in group 10, species should be selected from the most comparable windbreak suitability group. For example, for a shallow soil over bedrock, trees or shrubs would be selected from group 6D; an excessively wet soil would most closely match group 2.

Table 6.—Potential Cropland Limitations and Hazards

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
61:	
Arveson	Alkalinity
	Excessive saturated hydraulic conductivity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
118:	
Barnes	Pesticide and nutrient runoff
Buse	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
120:	
Barnes	Pesticide and nutrient runoff
	Slope
	Water erosion
Buse	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
156:	
Barnes	Pesticide and nutrient runoff
Svea	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
167:	
Bearden	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
296:	
Brantford	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
314:	
Buse	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
Barnes	Pesticide and nutrient runoff
	Slope
	Water erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
319:	
Buse	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
Barnes	Pesticide and nutrient runoff
	Slope
	Water erosion
391:	
Cavour	High sodium content
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Salt content
	Surface crusting
Cresbard	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Root limiting
450:	
Colvin	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
511:	
Divide	Alkalinity
	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
536:	
Eckman	Pesticide and nutrient runoff
	Slope
	Water erosion
Zell	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
539:	
Edgeley	Depth to rock Limited available water capacity Pesticide and nutrient leaching Restricted saturated hydraulic conductivity
541:	
Edgeley	Depth to rock Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Restricted saturated hydraulic conductivity
569:	
Embden	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
579:	
Embden	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Wind erosion
Egeland	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Wind erosion
595:	
Emrick	Pesticide and nutrient leaching
Cathay	Pesticide and nutrient leaching Pesticide and nutrient runoff Root limiting
597:	
Emrick	Pesticide and nutrient leaching
Heimdal	None
605:	
Esmond	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Heimdal	Pesticide and nutrient runoff Slope Water erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
753:	
Fram	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
Wyard	High water table
	Pesticide and nutrient leaching
769:	
Gardena	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
773:	
Gardena	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
Eckman	Pesticide and nutrient runoff
881:	
Hamerly	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
Tonka	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Restricted saturated hydraulic conductivity
884:	
Hamerly	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
Wyard	High water table
	Pesticide and nutrient leaching
893:	
Harriet	Alkalinity
	Flooding
	High sodium content
	High water table
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Salt content
	Surface crusting

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
988:	
Heimdal	Pesticide and nutrient runoff
Emrick	Pesticide and nutrient leaching Pesticide and nutrient runoff
998:	
Heimdal	Pesticide and nutrient runoff Slope Water erosion
Esmond	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
1001:	
Heimdal	Pesticide and nutrient runoff Slope Water erosion
Esmond	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
1015:	
Kensal	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching
1062:	
LaDelle	Pesticide and nutrient leaching Pesticide and nutrient runoff
1108:	
Larson	High sodium content Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting
Cathay	Pesticide and nutrient leaching Pesticide and nutrient runoff Root limiting
1188:	
Ludden	Alkalinity Flooding High water table Lime content

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
1188:(con't)	
Ludden	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Wind erosion
1189:	
Ludden, saline	Alkalinity
	Flooding
	High water table
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Salt content
	Wind erosion
1221:	
Maddock	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Wind erosion
Hecla	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Wind erosion
1267:	
Marysland	Alkalinity
	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
1268:	
Marysland, wet	Alkalinity
	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Surface crusting
	Wind erosion
1427:	
Parnell	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
1454:	
Wyndmere	Alkalinity Excessive saturated hydraulic conductivity High water table Lime content Pesticide and nutrient leaching Surface crusting Wind erosion
1466:	
Pits, sand and gravel	Alkalinity Depth to sand and gravel Excessive saturated hydraulic conductivity Lime content Limited available water capacity Limited organic matter Pesticide and nutrient leaching Pesticide and nutrient runoff Slope Surface rock fragments Water erosion
1710:	
Southam	Alkalinity High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting Wind erosion
1762:	
Svea	Pesticide and nutrient leaching
Barnes	None
1765:	
Svea	Pesticide and nutrient leaching Pesticide and nutrient runoff
Buse	Alkalinity Lime content Pesticide and nutrient runoff Surface crusting Wind erosion
1766:	
Svea	Pesticide and nutrient runoff Slope Water erosion
Buse	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
1769:	
Svea	Pesticide and nutrient leaching
Cresbard	Pesticide and nutrient leaching Pesticide and nutrient runoff Root limiting
1781:	
Swenoda	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Wind erosion
1843:	
Towner	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
1883:	
Vallers	Alkalinity High water table Lime content Pesticide and nutrient leaching Surface crusting Wind erosion
Parnell	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Poor tilth and compaction Restricted saturated hydraulic conductivity
1886:	
Hamerly, saline	Alkalinity High water table Lime content Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Salt content Surface crusting Wind erosion
Vallers, saline	Alkalinity High water table Lime content Limited available water capacity Pesticide and nutrient leaching Salt content Surface crusting Wind erosion
1970:	
Walum	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
1978:	
Water	Non-soil material

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
2118:	
Fram	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
Tonka	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Restricted saturated hydraulic conductivity
2121:	
Ferney	High sodium content
	High water table
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Salt content
	Surface crusting
2151:	
Binford	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Wind erosion
Coe	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
2152:	
Coe	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
Binford	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Water erosion
	Wind erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
2153:	
Edgeley	Depth to rock
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Restricted saturated hydraulic conductivity
	Slope
	Soil slumping
	Water erosion
Kloten	Alkalinity
	Depth to rock
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Restricted saturated hydraulic conductivity
	Slope
	Soil slumping
	Water erosion
Esmond	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
2156:	
Lamoure	Alkalinity
	Flooding
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
Rauville	Alkalinity
	Flooding
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
2157:	
Maddock	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Water erosion
	Wind erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
2157:(con't)	
Esmond	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
Embden	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Wind erosion
2158:	
Velva	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
2159:	
Walsh	Pesticide and nutrient runoff
2196:	
Bearden, saline	Alkalinity
	High water table
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Salt content
	Surface crusting
	Wind erosion
Colvin, saline	Alkalinity
	High water table
	Lime content
	Limited available water capacity
	Pesticide and nutrient leaching
	Salt content
	Surface crusting
	Wind erosion
2197:	
Edgeley	Depth to rock
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Restricted saturated hydraulic conductivity
	Slope
	Water erosion
Kloten	Alkalinity
	Depth to rock
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Restricted saturated hydraulic conductivity
	Slope
	Surface crusting
	Water erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
2198:	
Hamar	Excessive saturated hydraulic conductivity High water table Pesticide and nutrient leaching Wind erosion
Hecla	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
2199:	
Hamerly	Alkalinity High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Surface crusting Surface stones
Barnes	Pesticide and nutrient runoff Surface stones
Tonka	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Restricted saturated hydraulic conductivity Surface stones
2200:	
Letcher	Excessive saturated hydraulic conductivity High sodium content Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting Wind erosion
Swenoda	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Wind erosion
2201:	
Stirum	Alkalinity Excessive saturated hydraulic conductivity High sodium content High water table Lime content Limited available water capacity Pesticide and nutrient leaching Poor tilth and compaction Salt content Surface crusting Wind erosion

Table 6.—Potential Cropland Limitations and Hazards--(continued)

(See text for a description and criteria of the limitations and hazards listed in this table)

Map Symbol and Component Name	Cropland Limitations and Hazards
2201:(con't)	
Arveson, saline	Alkalinity
	Excessive saturated hydraulic conductivity
	High water table
	Limited available water capacity
	Pesticide and nutrient leaching
	Salt content
	Surface crusting
	Wind erosion
2202:	
Swenoda	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Wind erosion
Barnes	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Wind erosion
2203:	
Swenoda	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Wind erosion
Barnes	Excessive saturated hydraulic conductivity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Wind erosion
2204:	
Walsh	Pesticide and nutrient runoff
	Slope
	Water erosion
2205:	
Zell	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
Eckman	Pesticide and nutrient runoff
	Slope
	Water erosion

Table 7.—Map Unit Productivity Index and Farmland Designation

(Dashes (--) indicate an assignment has not been made. Entries in ( ) are for undrained conditions.)

Map Symbol	Spring Wheat Productivity Index	Farmland Designation
61	51 (29)	Prime farmland where drained
118	66	Prime farmland
120	52	Additional farmland of statewide importance
156	83	Prime farmland
167	89	Prime farmland
296	50	Other land
314	39	Other land
319	17	Other land
391	61	Other land
450	70(40)	Prime farmland where drained
511	63	Prime farmland
536	50	Additional farmland of statewide importance
539	79	Prime farmland
541	65	Prime farmland
569	70	Prime farmland
579	64	Prime farmland
595	78	Additional farmland of statewide importance
597	84	Prime farmland
605	33	Other Land
753	84	Prime farmland where drained

Table 7.—Map Unit Productivity Index and Farmland Designation--(continued)

(Dashes (--) indicate an assignment has not been made. Entries in () are for undrained conditions.)

Map Symbol	Spring Wheat Productivity Index	Farmland Designation
769	95	Prime farmland
773	83	Prime farmland
881	84(65)	Prime farmland where drained
884	84	Prime farmland where drained
893	21	Other land
988	79	Prime farmland
998	47	Additional farmland of statewide importance
1001	21	Other land
1015	57	Additional farmland of statewide importance
1062	94	Prime farmland
1108	52	Other Land
1188	68(41)	Prime farmland where drained
1189	33(27)	Other land
1221	39	Other land
1267	60(31)	Prime farmland where drained
1268	52(12)	Other Land
1427	72(22)	Other Land
1454	66	Prime farmland
1466	--	Other land
1710	54(6)	Other land

Table 7.—Map Unit Productivity Index and Farmland Designation--(continued)

(Dashes (--) indicate an assignment has not been made. Entries in () are for undrained conditions.)

Map Symbol	Spring Wheat Productivity Index	Farmland Designation
1762	92	Prime farmland
1765	69	Prime farmland
1766	53	Additional farmland of statewide importance
1769	82	Additional farmland of statewide importance
1781	76	Prime farmland
1843	46	Other land
1883	70(34)	Other land
1886	44(40)	Other land
1970	51	Additional farmland of statewide importance
1978	--	Water
2118	85(69)	Prime farmland where drained
2121	35	Other land
2151	38	Prime farmland when irrigated
2152	21	Other land
2153	23	Other land
2156	51(31)	Other land
2157	28	Other land
2158	61	Prime farmland
2159	85	Prime farmland
2196	40(38)	Other land
2197	44	Other land

Table 7.—Map Unit Productivity Index and Farmland Designation--(continued)

(Dashes (--) indicate an assignment has not been made. Entries in () are for undrained conditions.)

Map Symbol	Spring Wheat Productivity Index	Farmland Designation
2198	50	Other land
2199	29	Other land
2200	50	Other land
2201	28(25)	Other land
2202	68	Prime farmland
2203	57	Additional farmland of statewide importance
2204	67	Additional farmland of statewide importance
2205	20	Other land

Table 8.—Yields Per Acre of Crops

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes (--) indicate a yield is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Corn	Sunflowers	Grass-alfalfa hay[1]
	Bu/A	Bu/A	Bu/A	Bu/A	Lbs/A	T/A
61: Arveson	20 (12)	43 (26)	33 (20)	44 (26)	1,000 (600)	2.2 (1.1)
118: Barnes Buse	26	55	42	57	1,300	2.2
120: Barnes Buse	21	45	34	46	1,050	2.0
156: Barnes Svea	33	70	54	73	1,650	2.7
167: Bearden	36	77	59	79	1,800	2.8
296: Brantford	20	43	33	44	1,000	1.8
314: Buse Barnes	16	34	26	35	800	1.7
319: Buse Barnes	7	15	11	15	350	0.8
391: Cavour Cresbard	24	51	39	53	1,200	1.8
450: Colvin	28 (16)	60 (34)	46 (26)	62 (35)	1,400 (800)	3.0 (1.6)
511: Divide	25	53	41	55	1,250	2.3
536: Eckman Zell	20	43	33	44	1,000	2.0
539: Edgeley	32	68	52	70	1,600	2.4
541: Edgeley	26	55	42	57	1,300	2.1
569: Embden	28	60	46	62	1,400	2.2
579: Embden Egeland	26	55	42	57	1,300	2.0
595: Emrick Cathay	31	66	50	63	1,550	2.4

Table 8.—Yields Per Acre of Crops--(continued)

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes (--) indicate a yield is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Corn	Sunflowers	Grass-alfalfa hay[1]
	Bu/A	Bu/A	Bu/A	Bu/A	Lbs/A	T/A
597:	34	72	55	75	1,700	2.9
Emrick						
Heimdal						
605:	13	28	21	29	650	1.4
Esmond						
Heimdal						
753:	34	72	55	75	1,700	2.6
Fram						
Wyard						
769:	38	81	62	84	1,900	2.8
Gardena						
773:	33	70	54	73	1,650	2.6
Gardena						
Eckman						
881:	34 (26)	72 (55)	55 (42)	76 (57)	1,700 (1,300)	2.7 (2.7)
Hamerly						
Tonka						
884:	34	72	55	75	1,700	2.6
Hamerly						
Wyard						
893:	8	17	13	18	400	0.8
Harriet						
988:	32	68	52	70	1,600	2.7
Heimdal						
Emrick						
998:	19	40	31	42	950	2.0
Heimdal						
Esmond						
1001:	8	17	13	18	400	0.7
Heimdal						
Esmond						
1015:	23	49	37	51	1,150	1.9
Kensal						
1062:	38	81	62	84	1,900	3.0
LaDelle						
1108:	21	45	34	46	1,050	1.6
Larson						
Cathay						
1188:	27 (16)	57 (34)	44 (26)	59 (36)	1,350 (800)	2.8 (1.4)
Ludden						
1189:	13 (11)	28 (23)	21 (18)	39 (24)	650 (550)	1.3 (1.0)
Ludden, saline						

Table 8.—Yields Per Acre of Crops--(continued)

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes (--) indicate a yield is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Corn	Sunflowers	Grass-alfalfa hay[1]
	Bu/A	Bu/A	Bu/A	Bu/A	Lbs/A	T/A
1221: Maddock Hecla	16	34	26	35	800	1.8
1267: Marysland	24 (12)	51 (26)	39 (20)	53 (26)	1,200 (600)	2.7 (1.3)
1268: Marysland, wet	21 (5)	45 (11)	34 (8)	46 (11)	1,050 (250)	2.4 (0.5)
1427: Parnell	29 (9)	62 (19)	47 (15)	64 (20)	1,450 (450)	3.0 (1.0)
1454: Wyndmere	26	55	42	57	1,300	2.4
1466: Pits, sand and gravel	---	---	---	---	---	---
1710: Southam	22 (2)	47 (4)	36 (3)	43 (4)	1,100 (100)	2.1 (0.2)
1762: Svea Barnes	37	79	60	31	1,850	2.9
1765: Svea Buse	28	60	46	62	1,400	2.2
1766: Svea Buse	21	45	34	46	1,050	2.0
1769: Svea Cresbard	33	70	54	73	1,650	2.5
1781: Swenoda	30	64	49	66	1,500	2.4
1843: Towner	18	38	29	40	900	1.8
1883: Vallers Parnell	26 (14)	60 (30)	46 (23)	62 (31)	1,400 (700)	3.1 (1.6)
1886: Hamerly, saline Vallers, saline	18 (16)	38 (34)	29 (26)	40 (36)	900 (800)	1.9 (1.8)
1970: Walum	20	43	33	44	1,000	1.8
1978: Water	---	---	---	---	---	---

Table 8.--Yields Per Acre of Crops--(continued)

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes (--) indicate a yield is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Corn	Sunflowers	Grass-alfalfa hay[1]
	Bu/A	Bu/A	Bu/A	Bu/A	Lbs/A	T/A
2118: Fram Tonka	34 (28)	72 (60)	55 (46)	75 (62)	1,700 (1,400)	2.7 (2.7)
2121: Ferney	14	30	23	31	700	1.2
2151: Binford Coe	15	32	24	33	750	1.4
2152: Coe Binford	8	17	13	18	400	0.7
2153: Edgeley Kloten Esmond	9	19	15	20	450	1.9
2156: Lamoure Rauville	20 (12)	43 (26)	33 (20)	44 (26)	1,000 (600)	2.1 (1.2)
2157: Maddock Esmond Embden	11	23	18	24	550	1.2
2158: Velva	24	51	39	53	1,200	2.7
2159: Walsh	34	72	55	75	1,700	2.8
2196: Bearden, saline Colvin, saline	16 (15)	34 (32)	26 (24)	35 (33)	800 (750)	1.7 (1.5)
2197: Edgeley Kloten	18	38	29	40	900	1.8
2198: Hamar Hecla	20	43	33	44	1,000	2.0
2199: Hamerly Barnes Tonka	12	26	20	26	600	1.0

Table 8.—Yields Per Acre of Crops--(continued)

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes (--) indicate a yield is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Corn	Sunflowers	Grass-alfalfa hay[1]
	Bu/A	Bu/A	Bu/A	Bu/A	Lbs/A	T/A
2200: Letcher Swenoda	20	43	33	44	1,000	1.9
2201: Stirum Arveson, saline	10	21	16	22	500	0.8
2202: Swenoda Barnes	27	57	44	59	1,350	2.5
2203: Swenoda Barnes	23	49	37	51	1,150	2.3
2204: Walsh	27	57	44	59	1,350	2.6
2205: Zell Eckman	8	17	13	18	400	0.7

[1]Yield estimates for adapted species.

Table 9.—Interpretive Groupings Report

(Dashes (--) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map Symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
61:			
Arveson	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
118:			
Barnes	Loamy and Silty A1	2E	3
Buse	Thin Upland A2	3E	8
120:			
Barnes	Loamy and Silty A1	3E	3
Buse	Thin Upland A2	4E	8
156:			
Barnes	Loamy and Silty A1	2E	3
Svea	Overflow and Run-On A3	2E	1
167:			
Bearden	Limy Subirrigated A5	2E	1K
296:			
Brantford	Shallow to Gravel B1	3S	6G
314:			
Buse	Thin Upland A2	6E	10
Barnes	Loamy and Silty A1	4E	3
319:			
Buse	Steeply Sloping H3	7E	10
Barnes	Loamy and Silty A1	6E	10
391:			
Cavour	Claypan G1	4S	9L
Cresbard	Clayey Subsoils F1	2S	4
450:	Limy Subirrigated A5	2W (4W)	1K (2K)
Colvin	(Wet C1)		
511:			
Divide	Limy Subirrigated A5	3S	1K
536:			
Eckman	Loamy and Silty A1	3E	3
Zell	Thin Upland A2	4E	8
539:			
Edgeley	Moderately Deep Silty F2	2S	6D
541:			
Edgeley	Moderately Deep Silty F2	2E	6D
569:			
Embden	Sandy A6	3E	1
579:			
Embden	Sandy A6	3E	1
Egeland	Sandy A6	3E	5
595:			
Emrick	Overflow and Run-On A3	2E	1
Cathay	Clayey Subsoils F1	3S	3

Table 9.—Interpretive Groupings Report--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map Symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
597:			
Emrick	Overflow and Run-On A3	2E	1
Heimdal	Loamy and Silty A1	2E	3
605:			
Esmond	Thin Upland A2	6E	10
Heimdal	Loamy and Silty A1	4E	3
753:			
Fram	Limy Subirrigated A5	2E	1K
Wyard	Overflow and Run-On A3	2C	1
769:			
Gardena	Loamy and Silty A1	2C	1
773:			
Gardena	Overflow and Run-On A3	2E	1
Eckman	Loamy and Silty A1	2E	3
881:			
Hamerly	Limy Subirrigated A5	2E	1K
Tonka	Clayey A4 (Wet C1)	2W(4W)	1(2)
884:			
Hamerly	Limy Subirrigated A5	2E	1K
Wyard	Overflow and Run-On A3	2C	1
893:			
Harriet	Sodic-Saline G3	6S	10
988:			
Heimdal	Loamy and Silty A1	2E	3
Emrick	Overflow and Run-On A3	2E	1
998:			
Heimdal	Loamy and Silty A1	3E	3
Esmond	Thin Upland A2	4E	8
1001:			
Heimdal	Loamy and Silty A1	6E	10
Esmond	Steeply Sloping H3	7E	10
1015:			
Kensal	Shallow to Gravel B1	3S	6G
1062:			
LaDelle	Overflow and Run-On A3	2C	1
1108:			
Larson	Claypan G1	4S	9L
Cathay	Clayey Subsoils F1	3S	3
1188:			
Ludden	Clayey A4 (Wet C1)	2W(4W)	4C(2K)
1189:			
Ludden, saline	Saline G4	3S	9W

Table 9.—Interpretive Groupings Report--(continued)

(Dashes (—) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map Symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
1221:			
Maddock	Sands A7	4E	7
Hecla	Sands A7	4E	7
1267:			
Marysland	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
1268:			
Marysland, wet	Wet C1 (Wetland H6)	3W(5W)	2K(10)
1427:			
Parnell	Wet C1 (Wetland H6)	3W(5W)	2 (10)
1454:			
Wyndmere	Limy Subirrigated A5	3E	1K
1466:			
Pits, sand and gravel	---	8S	---
1710:			
Southam	Wet C1 (Wetland H6)	3W(8W)	2K(10)
1762:			
Svea	Overflow and Run-On A3	2C	1
Barnes	Loamy and Silty A1	2C	3
1765:			
Svea	Overflow and Run-On A3	2E	1
Buse	Thin Upland A2	3E	8
1766:			
Svea	Loamy and Silty A1	3E	3
Buse	Thin Upland A2	4E	8
1769:			
Svea	Overflow and Run-On A3	2C	1
Cresbard	Clayey Subsoils F1	2S	4
1781:			
Swenoda	Sandy A6	3E	1
1843:			
Towner	Sands A7	4E	7
1883:			
Vallers	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
Parnell	Wet C1 (Wetland H6)	3W(5W)	2K(10)
1886:			
Hamerly, saline	Saline G4	3S	9W
Vallers, saline	Saline G4	3S	9W
1970:			
Walum	Sandy A6	3E	6G
1978:			
Water	---	---	---

Table 9.—Interpretive Groupings Report--(continued)

(Dashes (—-) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map Symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
2118:			
Fram	Limy Subirrigated A5	2E	1K
Tonka	Clayey A4 (Wet C1)	2W(4W)	2(10)
2121:			
Ferney	Thin Claypan G2	6S	10
2151:			
Binford	Shallow to Gravel B1	3E	6G
Coe	Very Shallow to Gravel B2	6S	10
2152:			
Coe	Very Shallow to Gravel B2	7S	10
Binford	Shallow to Gravel B1	6E	6G
2153:			
Edgeley	Moderately Deep Silty F2	6E	6D
Kloten	Shallow H4	7E	10
Esmond	Steeply Sloping H3	7E	10
2156:			
Lamoure	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
Rauville	Wet C1 (Wetland H6)	3W(5W)	2K(10)
2157:			
Maddock	Sands A7	6E	7
Esmond	Thin Upland A2	6E	10
Embden	Sandy A6	4E	5
2158:			
Velva	Sandy A6	3E	5
2159:			
Walsh	Overflow and Run-On A3	2E	1
2196:			
Bearden, saline	Saline G4	3S	9W
Colvin, saline	Saline G4	3S	9W
2197:			
Edgeley	Moderately Deep Silty F2	3E	6D
Kloten	Shallow H4	6E	10
2198:			
Hamar	Sands A7	4E	1
Hecla	Sands A7	4E	7
2199:			
Hamerly	Stony H2	6S	10
Barnes	Stony H2	6S	10
Tonka	Stony H2	6S	10
2200:			
Letcher	Claypan G1	4S	9L
Swenoda	Sandy A6	3E	1

Table 9.—Interpretive Groupings Report--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map Symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
2201:			
Stirum	Sodic-Saline G3	6S	10
Arveson, saline	Saline G4	3S	9W
2202:			
Swenoda	Overflow and Run-On A3	3E	1
Barnes	Loamy and Silty A1	3E	3
2203:			
Swenoda	Sandy A6	4E	5
Barnes	Loamy and Silty A1	4E	3
2204:			
Walsh	Loamy and Silty A1	3E	3
2205:			
Zell	Thin Upland A2	7E	10
Eckman	Loamy and Silty A1	4E	10

Table 10.—Windbreak Suitability Groups

Expected Shrub Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-6	3-4	3-5	3-4	—	4-6
Buffaloberry, Silver	8-12	8-12	—	—	—	9-12
Caragana (Peashrub, Siberian)	8-10	8-10	7-8	—	—	8-10
Cherry, Europian Bird (Mayday)	10-15	—	10-15	—	—	10-12
Cherry, Nanking	6-8	—	4-6	—	—	5-7
Cherry, Mongolian	5-6	—	4-6	—	—	4-6
Cherry, Western Sand	4-6	—	—	—	—	4-6
Cotoneaster, Peking	8-10	7-9	8-10	—	—	7-9
Cotoneaster, Europian	10-12	9-11	8-12	—	—	7-9
Currant, Golden	5-7	—	4-6	—	—	5-6
Dogwood, Redosier	6-8	—	6-8	—	—	5-7
Forsythia, 'Meadowlark'	7-11	6-8	—	—	—	7-9
Honeysuckle, Amur	8-10	7-9	—	—	—	7-9
Honeysuckle, Blueleaf 'Freedom'	7-9	6-8	—	—	—	6-8
Honeysuckle, Tatarian	8-10	7-9	—	—	—	8-10
Indigo, False	7-9	6-8	7-9	7-9	—	5-7
Juneberry (Serviceberry)	6-8	—	5-7	—	—	5-7
Lilac, Common	10-12	10-12	8-10	8-10	—	8-10
Lilac, Late	10-12	8-10	10-12	8-10	—	8-10
Plum, American	7-9	—	6-7	—	—	7-9
Rose, Species	4-5	4-5	4-5	—	—	4-5
Sea-buckthorn	8-10	8-10	—	—	—	6-8
Silverberry	6-8	5-6	—	—	—	5-7
Sumac, Skunkbush	5-9	4-7	5-8	—	—	5-9
Willow, Sandbar	7-9	6-8	7-10	6-8	—	6-8
Viburnum, Nannyberry	12-16	—	12-14	—	—	10-12

Table 10.—Windbreak Suitability Groups--(continued)

Expected Shrub Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-5	4-5	3-4	—	—	—
Buffaloberry, Silver	7-8	7-8	4-7	4-6	4-6	—
Caragana (Peashrub, Siberian)	7-8	5-6	7-9	6-8	6-8	6-8
Cherry, Europian Bird (Mayday)	10-12	8-10	8-10	6-8	4-6	4-6
Cherry, Nanking	4-5	4-5	4-5	—	—	—
Cherry, Mongolian	4-6	4-6	4-5	—	—	—
Cherry, Western Sand	—	—	4-6	3-5	3-5	3-5
Cotoneaster, Peking	6-7	5-7	6-7	—	—	—
Cotoneaster, Europian	9-10	8-9	8-10	—	—	—
Currant, Golden	3-5	3-5	5-6	—	—	—
Dogwood, Redosier	4-6	4-6	—	—	—	—
Forsythia, ‘Meadowlark’	—	—	6-8	—	—	—
Honeysuckle, Amur	7-9	7-9	6-8	—	—	—
Honeysuckle, Blueleaf ‘Freedom’	6-8	6-8	5-7	4-6	4-6	4-6
Honeysuckle, Tatarian	7-8	7-8	6-7	5-7	5-7	5-7
Indigo, False	—	—	—	—	—	—
Juneberry (Serviceberry)	5-6	5-6	—	—	—	—
Lilac, Common	6-8	5-7	7-9	5-7	5-7	—
Lilac, Late	7-9	7-9	—	—	—	—
Plum, American	6-8	6-8	5-7	—	—	—
Rose, Species	4-5	3-4	3-4	2-4	2-4	2-4
Sea-buckthorn	6-8	6-8	5-7	4-6	4-6	4-6
Silverberry	—	—	5-7	4-6	4-6	4-6
Sumac, Skunkbush	4-7	4-7	5-9	6-7	6-7	6-7
Willow, Sandbar	5-6	5-6	—	—	—	—
Viburnum, Nannyberry	—	—	8-10	—	—	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Shrub Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Almond, Russian	—	—	—	—	—
Buffaloberry, Silver	4-5	4-5	—	4-5	—
Caragana (Peashrub, Siberian)	4-5	4-5	—	4-5	—
Cherry, Europian Bird (Mayday)	—	—	—	—	—
Cherry, Nanking	—	—	—	—	—
Cherry, Mongolian	—	—	—	—	—
Cherry, Western Sand	—	—	—	—	—
Cotoneaster, Peking	—	—	—	—	—
Cotoneaster, Europian	—	—	—	—	—
Currant, Golden	—	3-4	3-4	3-4	—
Dogwood, Redosier	—	—	—	—	—
Forsythia, 'Meadowlark'	—	—	—	—	—
Honeysuckle, Amur	—	—	—	—	—
Honeysuckle, Blueleaf 'Freedom'	4-5	4-5	—	4-5	—
Honeysuckle, Tatarian	5-6	5-6	—	5-6	—
Indigo, False	—	—	—	—	—
Juneberry, (Serviceberry)	—	—	—	—	—
Lilac, Common	5-6	5-6	—	5-6	—
Lilac, Late	—	—	—	—	—
Plum, American	—	—	—	—	—
Rose, Species	—	—	—	—	—
Sea-buckthorn	4-5	4-5	—	4-5	—
Silverberry	3-5	3-5	—	3-5	—
Sumac, Skunkbush	3-4	3-4	—	3-4	—
Willow, Sandbar	—	—	—	—	—
Viburnum, Nannyberry	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Deciduous Tree Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	16-20	15-18	—	—	—	15-17
Ash, Black	20-24	17-20	19-22	17-20	—	18-22
Ash, Green	21-26	19-24	21-26	19-24	—	20-25
Aspen, Quaking	27-32	22-27	27-32	22-27	—	—
Boxelder	20-25	—	16-20	—	—	19-24
Chokecherry, Common	11-14	9-12	9-11	7-9	—	10-12
Cottonwood, Species	45-50	40-45	43-48	35-40	—	—
Crabapple, Species	18-20	—	17-20	—	—	17-19
Elm, Japanese	29-35	24-30	—	—	—	29-35
Elm, Siberian	28-35	28-35	28-32	28-35	—	26-32
Hackberry, Common	20-25	18-23	20-25	18-23	—	20-25
Hawthorn, Arnold	10-12	8-10	9-11	6-8	—	9-11
Hawthorn, Downy	10-12	8-10	9-11	6-8	—	9-11
Honeylocust	20-25	18-20	20-25	—	—	18-20
Maple, Amur	12-14	—	9-11	—	—	11-12
Maple, Tatarian	12-14	—	9-11	—	—	11-12
Oak, Bur	20-25	18-23	—	—	—	18-20
Olive, Russian	15-19	15-19	15-19	15-19	—	15-19
Pear, Ussurian(Harbin)	16-18	—	14-16	—	—	16-18
Poplar, Hybrid Species	50-55	—	45-50	—	—	—
Poplar, White	33-40	33-35	33-35	33-35	—	25-30
Walnut, Black	22-28	—	—	—	—	17-21
Willow, Laurel	30-35	20-25	30-35	20-25	20-25	—
Willow, White	30-35	20-25	30-35	20-25	20-25	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Deciduous Tree Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—	—
Ash, Black	—	—	—	—	—	—
Ash, Green	18-20	18-20	15-19	14-18	14-18	—
Aspen, Quaking	—	—	—	—	—	—
Boxelder	—	—	—	—	—	—
Chokecherry, Common	8-10	7-9	8-10	7-9	7-9	—
Cottonwood, Species	—	—	—	—	—	—
Crabapple, Species	12-14	10-12	12-15	—	—	—
Elm, Japanese	26-30	26-30	26-30	19-22	19-22	—
Elm, Siberian	24-26	24-26	20-25	17-22	17-22	—
Hackberry, Common	16-18	16-18	15-18	—	—	—
Hawthorn, Arnold	7-9	7-9	8-10	6-8	6-8	—
Hawthorn, Downy	7-9	7-9	8-10	6-8	6-8	—
Honeylocust	—	—	15-18	—	—	—
Maple, Amur	—	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—	—
Oak, Bur	14-16	13-15	18-20	—	—	—
Olive, Russian	12-14	12-14	12-15	11-14	11-14	—
Pear, Ussurian(Harbin)	11-13	11-13	11-13	—	—	—
Poplar, Hybrid Species	—	—	—	—	—	—
Poplar, White	—	—	—	—	—	—
Walnut, Black	—	—	—	—	—	—
Willow, Laurel	—	—	—	—	—	—
Willow, White	—	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Deciduous Tree Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—
Ash, Black	—	—	—	—	—
Ash, Green	12-16	9-11	9-10	9-13	—
Aspen, Quaking	—	—	—	—	—
Boxelder	—	—	—	—	—
Chokecherry, Common	—	—	—	—	—
Cottonwood, Species	—	—	—	—	—
Crabapple, Species	—	—	—	—	—
Elm, Japanese	19-21	11-15	—	11-15	—
Elm, Siberian	14-18	10-12	—	10-12	—
Hackberry, Common	—	—	—	—	—
Hawthorn, Arnold	—	—	—	—	—
Hawthorn, Downy	—	—	—	—	—
Honeylocust	—	—	—	—	—
Maple, Amur	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—
Oak, Bur	—	—	—	—	—
Olive, Russian	11-14	6-8	6-8	8-10	—
Pear, Ussurian(Harbin)	—	8-9	—	—	—
Poplar, Hybrid Species	—	—	—	—	—
Poplar, White	—	—	—	—	—
Walnut, Black	—	—	—	—	—
Willow, Laurel	—	—	—	—	—
Willow, White	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Conifer Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	12-15	10-12	12-15	10-13	—	8-11
Juniper, Rocky Mountain	12-15	10-12	11-13	8-9	—	12-15
Larch, Siberian	18-22	—	—	—	—	17-21
Pine, Ponderosa	18-22	15-17	17-19	—	—	18-22
Pine, Scotch	18-20	—	16-18	—	—	18-20
Redcedar, Eastern	12-15	10-12	11-13	8-9	—	12-15
Spruce, Black Hills	17-20	—	15-18	—	—	12-15
Spruce, Colorado Blue	17-20	—	15-18	—	—	15-19
Spruce, White	17-20	—	15-18	—	—	15-19

Table 10.— Windbreak Suitability Groups--(continued)

Expected Conifer Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	7-10	7-10	—	—	—	—
Juniper, Rocky Mountain	10-12	10-12	11-13	9-11	9-11	7-9
Larch, Siberian	—	—	15-19	—	—	—
Pine, Ponderosa	16-17	16-17	16-20	11-16	11-16	11-15
Pine, Scotch	—	—	—	—	—	—
Redcedar, Eastern	10-12	10-12	11-13	9-11	9-11	8-10
Spruce, Black Hills	13-15	13-15	—	—	—	—
Spruce, Colorado Blue	13-15	13-15	—	—	—	—
Spruce, White	13-15	13-15	—	—	—	—

Table 10.—Windbreak Suitability Groups--(continued)

Expected Conifer Heights at 20 Years

(Dashes (--) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	—	—	—	—	—
Juniper, Rocky Mountain	6-8	6-7	5-6	6-7	—
Larch, Siberian	—	—	—	—	—
Pine, Ponderosa	11-15	8-10	—	8-10	—
Pine, Scotch	—	—	—	—	—
Redcedar, Eastern	7-9	6-7	5-6	6-7	—
Spruce, Black Hills	—	—	—	—	—
Spruce, Colorado Blue	—	—	—	—	—
Spruce, White	—	—	—	—	—

Rangeland

Rangeland makes up about 45,000 acres or 10 percent of the land in Griggs County. The majority of rangeland is on rolling to steep dissected till plains and associated wetlands and in stream valleys and on outwash plains. The soils are generally unsuited to poorly suited for cultivated crops. Rangeland is used primarily for grazing by domestic livestock; however, it also provides wildlife habitat, watershed protection, recreational areas, and aesthetic value.

Rangeland is defined as land on which the native vegetation (historic climax or natural potential plant community) is predominantly grass, grasslike plants, forbs, and shrubs. Rangeland includes natural grasslands, savannas, marshes, and wet meadows. Cultural treatments, such as fertilization and cultivation, generally are not used or needed to maintain productivity of rangeland. The composition and production of the plant community are largely determined by soil, climate, topography, and grazing influences.

Range Sites

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.

Soils vary in their capacity to produce grass and other native plants. Soils that produce similar kinds, proportion, and amounts of vegetation are grouped into a range site.

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. Over time, the combination of plants best suited to a particular soil and climate has become established. In the absence of excessive disturbances, this group of plants is the natural plant community or climax community for the site. Natural plant communities are not static but vary slightly from year to year and place to place. The natural potential plant community is generally, but not always, the most productive and diverse combination of plants that may occur on a site.

The relationship between soils and vegetation was determined during this survey. In most cases, range sites 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 sites. Soil reaction, salt content, and a seasonal high water table are also important. Many different range sites occur in the survey area. Range sites for each map unit component under undrained conditions are given in Table 11, “Range Sites.“

The following paragraphs describe soil and landscape features and limitations associated with the range sites in Major Land Resource Area (MLRA) 55B. Some of these range sites may not occur in Griggs County.

Clayey range site. These are very deep, well and moderately well drained, moderately fine and fine textured soils. Saturated hydraulic conductivity is slow or very slow. Available water capacity is high. This site is on nearly level to gently rolling glacial till plains, lake plains, and terraces of large streams. Slope ranges from 1 to 9 percent.

Site retrogression results in a decrease in the abundance of such plants as western wheatgrass, porcupinegrass, green needlegrass, and prairie junegrass. The plants that usually increase under these conditions are needleandthread, blue grama, fringed sagewort, and upland sedges. Further deterioration may result in a dominance of blue grama, upland sedges, western ragweed, and fringed sagewort, and invasion of Kentucky bluegrass.

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 reduce runoff.

Claypan range site. These are very deep, moderately well and well drained soils. They have moderately coarse to moderately fine textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to fine textured and are high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is moderate. This site is on nearly level to undulating glacial till plains and lake plains. Slope ranges from 0 to 6 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and western wheatgrass. The plants that tend to increase in abundance under retrogression include inland saltgrass, blue grama, Sandberg bluegrass, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagewort, broom snakeweed, and annual forbs.

This site is easily damaged by mismanagement. Because of a dense subsoil and the content of salts in the soil, reestablishing the vegetation is difficult in denuded areas. Management that maintains an abundance of the climax species will maintain production and protect the soil from erosion.

Limy Subirrigated range site. These are very deep soils that are typically somewhat poorly drained, but include some moderately well drained soils. They have a loamy fine sand to silty clay loam surface layer and typically have a water table at about 1.5 to 3.5 feet during the spring and early summer. These soils have a layer high in lime within 16 inches of the surface. This site is on level, nearly level, and gently sloping glacial lake plains, glacial till plains, and outwash plains. Slope ranges from 0 to 6 percent.

Site retrogression usually results in a decrease in the abundance of plants such as big bluestem, indiangrass, switchgrass, and Maximilian sunflower. Little bluestem usually increases initially in abundance under these conditions, but it eventually decreases with more severe deterioration. Further deterioration results in a dominance of Baltic rush, common spikerush, annual grasses and forbs, and invasion of Kentucky bluegrass.

Generally, no major problems affect management. The dominant warm-season grasses on this site provide high-quality forage and wildlife habitat late in the growing season.

Overflow range site. These are very deep, moderately well and well drained, moderate to moderately fine textured soils that regularly receive additional run-on from surrounding uplands or flooding. Saturated hydraulic conductivity is moderate and available water capacity is high to very high. This site occurs on nearly level swales and depressions on glacial till plains and on stream terraces and flood plains. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of plants such as big bluestem, green needlegrass, prairie dropseed, and switchgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, sun sedge, and fescue sedge. Further deterioration results in a dominance of blue grama and sedges, and invasion of Kentucky bluegrass.

As a result of flooding and the upland runoff received by this site, it is very productive when properly managed.

Saline Lowland range site. These are very deep, somewhat poorly and poorly drained, medium and fine textured saline soils. Also included are some saline-sodic soils. This range site receives additional water from ground water seepage and/or run-on. Surface layers commonly are saline. Saturated hydraulic conductivity is moderate to very slow and available water capacity is moderate. This site occurs on shallow basins and lake plains and on low terraces and bottom lands along streams. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, and western wheatgrass. The plants that increase in abundance under these conditions are inland saltgrass, alkali muhly, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, silverweed cinquefoil, and western dock.

A high content of salts and a moderate available water capacity limit production on this site. Proper management of the adapted salt-tolerant plants will maintain optimum production. If the plant community has been severely damaged, however, the site recovers slowly. Wind and water erosion are hazards in denuded areas. Stock water ponds on this site frequently contain salty water.

Sands range site. These are very deep, well or excessively drained, coarse textured soils. Saturated hydraulic conductivity is rapid and available water capacity is low to moderate. Soils on this site are highly susceptible to wind erosion. This site is on nearly level to steep outwash and delta plains. Slope ranges from 1 to 35 percent.

Site retrogression generally results in a decrease in the abundance of such plants as prairie sandreed, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, needleandthread, upland sedges, and forbs. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, fringed sagewort, green sagewort, cudweed sagewort, and prairie rose.

The limited available water capacity and the hazard of wind erosion are concerns in managing this site. In severely disturbed areas, blowouts are common. The vegetation responds rapidly to improved management.

Sandy range site. These are very deep, well drained, moderately coarse textured soils. Saturated hydraulic conductivity is moderately rapid and available water capacity is moderate. These soils are friable and susceptible to wind erosion. This site is on nearly level to rolling glacial till plains, lake plains, and outwash plains. Slope ranges from 1 to 15 percent.

Site retrogression generally results in a decrease in the abundance of such plants as western wheatgrass, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase under these conditions are needleandthread, blue grama, upland sedges, sand dropseed, and annual forbs. Further deterioration results in a dominance of blue grama, upland sedges, and forbs, such as western yarrow, green sagewort, and fringed sagewort.

Moderate available water capacity is a concern in managing this site. Also, wind erosion is a hazard in denuded areas. Management that maintains an abundance of the climax species results in a productive natural plant community and provides a good protective plant cover.

Sandy Claypan range site. These are very deep, somewhat poorly drained soils. They have moderately coarse textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to medium textured and are high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is low. This site is on nearly level outwash and lake plains. Slope ranges from 0 to 3 percent.

Site retrogression 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 sagewort. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, annual forbs, and annual grasses.

The soils have a dense, sodic subsoil and limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover will control erosion.

Shallow Clay range site. These are shallow, fine textured soils overlying weathered shales at less than 20 inches. They are well drained. Permeability is slow or very slow and available water capacity is very low. This site occurs on undulating to very steep uplands. Slope ranges from 3 to 35 percent.

Low available water capacity limits production on this site. The site is fragile and the plant community can deteriorate rapidly. The plant community should be kept near its potential and maintained in a high state of vigor in order to optimize use of available moisture.

Site retrogression results in a decrease in the abundance of plants such as western wheatgrass, green needlegrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, needleandthread, Sandberg bluegrass, needleleaf sedge, and other upland sedges. Further deterioration may result in an abundance of shortgrasses, fringed sagewort, upland sedges, and undesirable forbs and shrubs.

Shallow to Gravel range site. These are shallow, moderately coarse and medium textured soils overlying sand and gravel at about 20 inches. They are somewhat excessively drained. Saturated hydraulic conductivity is moderate over moderately rapid and available water capacity is low. This site occurs on nearly level to steep outwash plains and stream terraces. Slope ranges from 1 to 25 percent.

Site retrogression results in a decrease in the abundance of such plants as green needlegrass, western wheatgrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, and fringed sagewort.

Low available water capacity limits production on this site. The site is fragile, and the plant community can deteriorate rapidly. The plant community should be kept near its potential, and maintained in a high state of vigor, in order to optimize use of available moisture.

Silty range site. These are moderately deep and very deep, well drained, medium and moderately fine textured soils. Saturated hydraulic conductivity is moderate and available water capacity is high or very high. This site is on nearly level to steep glacial till plains, lake plains, and high stream terraces. Slope ranges from 1 to 25 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, western wheatgrass, and porcupinegrass. The plants that increase in abundance under these conditions are needleandthread, blue grama, threadleaf sedge, needleleaf sedge, and fringed sagewort. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, fringed sagewort, and other forbs. Kentucky bluegrass often invades as conditions deteriorate.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form in denuded areas.

Subirrigated range site. These are very deep, somewhat poorly and poorly drained, moderately coarse to moderately fine textured soils. These soils have a high water table which keeps the rooting zone moist for most of the growing season. Saturated hydraulic conductivity is moderate to moderately slow and available water capacity is high. This site is on flats and in depressions and drainageways on glacial till plains, lake plains, and outwash plains. Slope ranges from 0 to 3 percent.

Site retrogression 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, Baltic rush, common spikerush, and various forbs. Further deterioration results in a dominance of Kentucky bluegrass, other short grasses, grasslike plants, and forbs.

The high percentage of warm-season species on this site can provide high quality forage and wildlife habitat late in the growing season.

Subirrigated Sands range site. These are very deep, somewhat poorly drained, coarse textured soils. Saturated hydraulic conductivity is rapid and available water capacity is low. This site occurs on nearly level or undulating delta plains. Slope ranges from 0 to 6 percent.

Site retrogression results in a decrease in the abundance of such plants as big bluestem, switchgrass, porcupinegrass, and Maximilian sunflower. The plants that increase in abundance under these conditions are sedges, undesirable forbs, and quaking aspen. Kentucky bluegrass is a common invader on this site. When the canopy of quaking aspen approaches 100 percent, the understory is dominated by sedges and shrubs.

The high percentage of warm-season species on this site can provide high-quality forage and wildlife habitat late in the growing season. The combination of grasses, sedges, forbs, shrubs, and trees provides a diversity of wildlife habitat and lends variety and fall color to the landscape. Because of the wide variation in canopy cover, forage production may differ on individual areas of this site. Wind erosion is a concern. It can be controlled by maintaining or reestablishing the climax grasses.

Thin Claypan range site. These are very deep, somewhat poorly to moderately well drained soils. The surface layer is thin, moderately coarse to moderately fine textured, and underlain by a dense sodic subsoil. The subsoils are moderately coarse to fine textured and high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is low to moderate. This site is on nearly level to rolling glacial till plains and lake plains. Slope ranges from 0 to 9 percent.

Site retrogression usually 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, and alkali muhly. Further deterioration results in a dominance of short grasses, sedges, fringed sagewort, broom snakeweed, and other forbs.

Because of the dense subsoil and high content of subsoil salts, productivity is quite low on this site. Ponds constructed on this site are likely to be salty.

Thin Sands range site. These are very deep, excessively drained, coarse textured soils that have a thin surface horizon. Saturated hydraulic conductivity is rapid and available water capacity is low or very low. These soils are highly susceptible to wind erosion and require careful management. This site is on nearly level to very steep glacial outwash plains and wind-worked delta plains. Slope ranges from 1 to 50 percent.

Site retrogression results in a decrease in the abundance of such plants as prairie sandreed, prairie junegrass, little bluestem, sideoats grama, and sand bluestem. The plants that increase in abundance under these conditions are sand dropseed and upland sedges. Further deterioration results in a dominance of upland sedges, blue grama, and various forbs and invasion of Kentucky bluegrass.

This site is very fragile. It is subject to wind erosion if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in disturbed areas. Proper management will maintain protective cover and optimum production.

Thin Upland range site. These very deep, well drained, medium and moderately fine textured soils have a thin surface horizon. Saturated hydraulic conductivity is moderately slow and available water capacity is high. This site is on gently sloping to very steep glacial till uplands. Slope ranges from 3 to 50 percent.

Site retrogression results in a decrease in the abundance of such plants as little bluestem, needleandthread, and sideoats grama. The plants that increase in abundance under these conditions are blue grama, red threeawn, upland sedges, and various forbs. Further deterioration results in a dominance of blue grama, upland sedges, and fringed sagewort.

Generally, no major problems affect management of this site. Wind and water erosion are a problem in denuded areas. In the more sloping areas, however, gullies can form along trails.

Very Shallow range site. These are very shallow soils over sand and gravel. They are moderately coarse to medium textured soils underlain by sand and gravel at about 10 inches. They are excessively drained. Saturated hydraulic conductivity is rapid and available water capacity is very low. This site is on nearly level to steep outwash plains and terraces. Slope ranges from 1 to 35 percent.

Site retrogression results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and various forbs and shrubs.

Available water capacity is very low on this site. Water erosion is a hazard in the more sloping areas. Gullies can form along trails and in denuded areas. Productivity can be maintained by proper management of the dominant mid-grasses.

Wet Meadow range site. These are very deep, poorly drained, medium and fine textured soils that are briefly flooded in the spring and summer. The soils dry at the surface by midsummer but have water in the root zone. This site occurs in swales and depressions on glacial till plains, glacial lake plains, and outwash channels. The site normally receives additional water from surface runoff and/or underground seepage. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of slim sedge, wooly sedge, northern reedgrass, prairie cordgrass, and switchgrass. The plants that increase in abundance under these conditions are fescue sedge, common spikerush, Baltic rush, mat muhly, and fowl bluegrass. Further deterioration results in a dominance of low-growing sedges, short grasses, western dock, and Canada thistle.

This site is easily damaged when it is wet. Grazing during wet periods results in compaction, trampling, and root shearing. The site also is an excellent source of high quality prairie hay.

Wetland range site. These are very deep, very poorly drained soils. Soil texture has little affect as to the kind of vegetation on the site. Water stands over the surface for a major part of the growing season. Saturated hydraulic conductivity of these soils is slow and available water capacity is high. This site is in depressions in glacial till plains, lake basins, and outwash channels. This site normally receives additional amounts of water from surface run-on and/or underground seepage. Slope is commonly less than 1 percent.

Site retrogression results in a decrease in the abundance of such plants as rivergrass, slough sedge, prairie cordgrass, and northern reedgrass. The plants that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a dominance of Baltic rush, common spikesedge, and Mexican dock.

This site is easily damaged when it is wet. Grazing during wet periods results in soil compaction, trampling, and root shearing. Climax vegetation and the important wetland wildlife values are maintained under proper management.

Range Site Plant Community, Composition, and Production

Characteristic vegetation, species composition, total annual production, and stocking rates by condition class are shown in Table 12, “Range Site Descriptions.”

The **characteristic vegetation** consists of grasses, grasslikes, forbs, shrubs, and trees that dominate the natural potential plant community on each range site. The plant species within these groups are listed by **common name**. Under **composition by weight,** the expected percentage of the total annual production is given for each major species and groups of minor species making up the characteristic vegetation.

The range site description helps interpret the ecological and utilitarian values of a given site, including grazing, wildlife habitat, watershed protection, recreation, and others.

Total annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland, supporting the potential natural plant community. It includes all vegetation, whether or not palatable to grazing animals. It includes the current year’s herbaceous growth, as well as growth of leaves, twigs, and fruit of woody plants. It does not include the increase in stem diameter of trees and shrubs. Potential production depends on the kind of range site. Current production depends on the rangeland condition and the amount of moisture available to the plants during the growing season. Production is expressed in pounds per acre of air-dry herbage for **favorable, average,** and **unfavorable** years, as determined by the amount and distribution of precipitation and the temperatures favorable to growing conditions.

Stocking Rates are based on production and expressed as **animal-unit months** per acre for **excellent, good, fair,** and **poor** range condition classes. Animal-Unit Month (AUM) is the amount of forage required monthly by an animal unit, generally described as one mature cow and one calf up to 6 months old.

Range Condition

Range condition indicates the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is determined by comparing the present plant community with the natural potential plant community on a particular range site. The more closely the existing community resembles the potential community, the higher the range condition. Range condition is an ecological rating only, not a forage value rating. Range condition is expressed as **excellent, good, fair,** or **poor,** depending on how closely the present plant community resembles the natural potential plant community. **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.

In some cases the plant community found on a site may not look similar to the potential plant community described in Table 12. This is usually due to a lower condition class, reflecting past disturbances, or in some cases long-term exclusion from grazing or fire. Abnormal disturbances that change the natural plant community include prolonged overgrazing or season-long grazing, excessive or untimely burning, erosion, and plowing. Under these circumstances, some of the climax plants decrease in proportion while others increase. Also, plants which were not part of the original native plant community may invade the site. A very severe disturbance, such as plowing, can completely destroy the natural plant community, resulting in dominance of annuals or weedy perennials of a lower plant successional status. If the plant community has not deteriorated significantly, it eventually can return to a higher condition class under proper range management.

Range Management

Range management requires a knowledge of the kinds of soils and of the potential natural plant community. It also requires an evaluation of the present range condition and trend. The primary objective in range management is to manipulate grazing in such a manner that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum production and diversity of vegetation, suppression of undesirable brush and weeds, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets forage needs, provides wildlife habitat, and protects soil and water resources.

Ecologically sound range management maintains excellent or good range condition. Water is conserved, yields are optimized, and soils are protected. An important management concern is recognizing the changes in the plant community that take place gradually and that 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 can recover from prolonged overgrazing or other disturbance, if the climax species have not been completely eliminated from the plant community. Generally an adequate population of climax plants remains to restore the rangeland to excellent condition through sound grazing management. In areas where the climax plant community has been severely disturbed or destroyed, range seeding can accelerate improvement in range condition. Seeding the proper climax species also can restore productive rangeland on areas of depleted or low quality cropland or pastureland. Brush suppression, water developments, fencing, and other mechanical practices may be needed to facilitate proper grazing management for range improvement on some rangeland. Proper grazing management is the key to maintaining or improving the productivity and diversity of rangeland.

For additional information about rangeland management, contact the local Natural Resources Conservation Service or Cooperative Extension Service office.

Table 11.—Range Sites

(Dashes (--) indicate an interpretive group is not assigned. Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
61:	
Arveson	Wet Meadow
118:	
Barnes	Silty
Buse	Thin Upland
120:	
Barnes	Silty
Buse	Thin Upland
156:	
Barnes	Silty
Svea	Overflow
167:	
Bearden	Limy Subirrigated
296:	
Brantford	Shallow to Gravel
314:	
Buse	Thin Upland
Barnes	Silty
319:	
Buse	Thin Upland
Barnes	Silty
391:	
Cavour	Claypan
Cresbard	Silty
450:	
Colvin	Wet Meadow
511:	
Divide	Limy Subirrigated
536:	
Eckman	Silty
Zell	Thin Upland
539:	
Edgeley	Silty
541:	
Edgeley	Silty
569:	
Embden	Sandy
579:	
Embden	Overflow
Egeland	Sandy

Table 11.—Range Sites--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
595:	
Emrick	Overflow
Cathay	Clayey
597:	
Emrick	Overflow
Heimdal	Silty
605:	
Esmond	Thin Upland
Heimdal	Silty
753:	
Fram	Limy Subirrigated
Wyard	Overflow
769:	
Gardena	Silty
773:	
Gardena	Overflow
Eckman	Silty
881:	
Hamerly	Limy Subirrigated
Tonka	Wet Meadow
884:	
Hamerly	Limy Subirrigated
Wyard	Overflow
893:	
Harriet	Saline Lowland
988:	
Heimdal	Silty
Emrick	Overflow
998:	
Heimdal	Silty
Esmond	Thin Upland
1001:	
Heimdal	Silty
Esmond	Thin Upland
1015:	
Kensal	Shallow to Gravel
1062:	
LaDelle	Silty
1108:	
Larson	Claypan
Cathay	Silty
1188:	
Ludden	Wet Meadow

Table 11.—Range Sites--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
1189:	
Ludden, saline	Saline Lowland
1221:	
Maddock	Sands
Hecla	Sands
1267:	
Marysland	Wet Meadow
1268:	
Marysland, wet	Wetland
1427:	
Parnell	Wetland
1454:	
Wyndmere	Limy Subirrigated
1466:	
Pits, sand and gravel	--
1710:	
Southam	--
1762:	
Svea	Overflow
Barnes	Silty
1765:	
Svea	Overflow
Buse	Thin Upland
1766:	
Svea	Silty
Buse	Thin Upland
1769:	
Svea	Overflow
Cresbard	Silty
1781:	
Swenoda	Sandy
1843:	
Towner	Sands
1883:	
Vallers	Wet Meadow
Parnell	Wetland
1886:	
Hamerly, saline	Saline Lowland
Vallers, saline	Saline Lowland
1970:	
Walum	Sandy

Table 11.—Range Sites--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
1978:	
Water	--
2118:	
Fram	Limy Subirrigated
Tonka	Wet Meadow
2121:	
Ferney	Thin Claypan
2151:	
Binford	Shallow to Gravel
Coe	Very Shallow
2152:	
Coe	Very Shallow
Binford	Shallow to Gravel
2153:	
Edgeley	Silty
Kloten	Shallow Clay
Esmond	Thin Upland
2156:	
Lamoure	Wet Meadow
Rauville	Wetland
2157:	
Maddock	Sands
Esmond	Thin Upland
Embden	Sandy
2158:	
Velva	Sandy
2159:	
Walsh	Overflow
2196:	
Bearden, saline	Saline Lowland
Colvin, saline	Saline Lowland
2197:	
Edgeley	Silty
Kloten	Shallow Clay
2198:	
Hamar	Subirrigated Sands
Hecla	Sands
2199:	
Hamerly	Limy Subirrigated
Barnes	Silty
Tonka	Wet Meadow

Table 11.—Range Sites--(continued)

(Dashes (--) indicate an interpretive group is not assigned. Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
2200:	
Letcher	Sandy Claypan
Swenoda	Sandy
2201:	
Stirum	Subirrigated
Arveson, saline	Saline Lowland
2202:	
Swenoda	Overflow
Barnes	Silty
2203:	
Swenoda	Sandy
Barnes	Silty
2204:	
Walsh	Silty
2205:	
Zell	Thin Upland
Eckman	Silty

Table 12.— Range Site Descriptions

Clayey Range Site

Characteristic Vegetation	Common Name (Plant Community)		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Green Needlegrass		20
	Western Wheatgrass		35
	Other Perennial Grasses		10
	Bearded Wheatgrass		5
	Porcupinegrass		5
	Blue Grama		5
	Needleandthread	*	
	Plains Reedgrass	*	10
	Prairie Dropseed	*	
	Prairie Junegrass	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	Trace
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Goatsbeard	*	
	Prairie Coneflower	*	10
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2600 to 2900
Average	2250 to 2550
Unfavorable	1900 to 2200

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.75 to 1.00
Good	0.50 to 0.75
Fair	0.25 to 0.50
Poor	0.10 to 0.25

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Claypan Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		25
	Blue Grama		15
	Green Needlegrass		10
	Needleandthread		10
	Prairie Junegrass		5
	Bearded Wheatgrass		5
	Inland Saltgrass	*	
	Porcupinegrass	*	5
	Tumblegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedge/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Mousear Chickweed	*	
	Rush Skeletonplant	*	10
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2000 to 2250
Average	1700 to 1950
Unfavorable	1450 to 1650

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Limy Subirrigated Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Little Bluestem		45
	Big Bluestem		15
	Indiangrass	*	10
	Switchgrass	*	
	Green Needlegrass	*	
	Needleandthread	*	
	Slender Wheatgrass	*	10
	Western Wheatgrass	*	
	Other Perennial Grasses	*	
	Rushes	*	10
	Sedge Species	*	
Forbs (5% to 15% of Total)	American Licorice	*	
	Goldenrod Species	*	
	Maximillian Sunflower	*	10
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	4300 to 4800
Average	3700 to 4200
Unfavorable	3100 to 3600

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.20 to 1.60
Good	0.80 to 1.20
Fair	0.40 to 0.80
Poor	0.10 to 0.40

*Indicates the composition for species group

**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Overflow Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Big Bluestem		30
	Bearded Wheatgrass		5
	Green Needlegrass		5
	Porcupinegrass		5
	Prairie Cordgrass		5
	Prairie Dropseed		5
	Switchgrass		5
	Western Wheatgrass		5
	Canada Wildrye	*	
	Needleandthread	*	5
	Northern Reedgrass	*	
	Indiangrass	*	
	Mat Muhly	*	5
	Tall Dropseed	*	
	Blue Grama	*	5
	Other Perennial Grasses	*	
	Fescue Sedge	*	
	Penn Sedge	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Heath Aster	*	
	Maximillian Sunflower	*	
	Silverleaf Scurfpea	*	10
	Wild Blue Lettuce	*	
	Woolly Goldenrod	*	
	Other Sedges/Rushes	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	
	Prairie Rose	*	5
	Other Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3600 to 4000
Average	3175 to 3575
Unfavorable	2750 to 3150

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.05 to 1.40
Good	0.70 to 1.05
Fair	0.35 to 0.70
Poor	0.10 to 0.35

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Saline Lowland Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		45
	Slender Wheatgrass		15
	Inland Saltgrass		10
	Nuttall Alkaligrass		5
	Alkali Cordgrass	*	
	Foxtail Cordgrass	*	
	Mat Muhly	*	10
	Plains Bluegrass	*	
	Other Perennial Grasses	*	
	Prairie Bulrush	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Alkali Plantain	*	
	Silverweed	*	10
	Western Dock	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3200 to 3500
Average	2850 to 3150
Unfavorable	2500 to 2800

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.90 to 1.20
Good	0.60 to 0.90
Fair	0.30 to 0.60
Poor	0.10 to 0.30

*Indicates the composition for species group
**Animal units per month

Table 12.—Range Site Descriptions--(continued)

Sands Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Prairie Sandreed		25
	Needleandthread		10
	Blue Grama		5
	Porcupinegrass		5
	Sand Bluestem		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Canada Wildrye	*	15
	Little Bluestem	*	
	Sand Dropseed	*	
	Green Needlegrass	*	
	Prairie Junegrass	*	10
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Hairy Goldaster	*	
	Purple Coneflower	*	15
	Purple Prairieclover	*	
	Stiff Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2950 to 3300
Average	2575 to 2925
Unfavorable	2200 to 2550

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Sandy Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Prairie Sandreed		25
	Needleandthread		15
	Blue Grama		5
	Green Needlegrass		5
	Porcupinegrass		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	
	Prairie Junegrass	*	10
	Little Bluestem	*	
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Goatsbeard	*	
	Green Sagewort	*	
	Heath Aster	*	15
	Western Ragweed	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Other Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2850 to 3200
Average	2475 to 2825
Unfavorable	2100 to 2450

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Sandy Claypan Range Site

Plant Community		
Characteristic Vegetation	Common Name	Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass	35
	Blue Grama	20
	Needleandthread	20
	Prairie Junegrass *	5
	Other Perennial Grasses *	
	Sun Sedge *	5
	Threadleaf Sedge *	
Forbs (5% to 15% of Total)	Fringed Sagewort *	
	Rush Skeletonplant *	
	Scarlet Globemallow *	5
	Other Perennial Forbs *	
Shrubs and Trees (5% to 15% of Total)	Silver Sagebrush *	
	Western Snowberry *	10
	Other Shrubs *	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3200 to 3700
Average	2600 to 3100
Unfavorable	2000 to 2500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Shallow Clay Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		15
	Green Needlegrass		15
	Needleandthread		10
	Blue Grama		5
	Plains Muhly		5
	Sideoats Grama		5
	Little Bluestem		5
	Porcupinegrass		5
	Prairie Deopseed	*	Trace
	Prairie Junegrass	*	
	Red Threeawn	*	10
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Black Samson	*	
	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Hairy Goldaster	*	
	Purple Prairieclover	*	10
	Rush Skeletonplant	*	
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Buffaloberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1850 to 2000
Average	1600 to 1750
Unfavorable	1350 to 1500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group

**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Shallow to Gravel Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		25
	Western Wheatgrass		20
	Blue Grama		10
	Green Needlegrass		10
	Bearded Wheatgrass		5
	Plains Muhly	*	
	Porcupinegrass	*	5
	Prairie Junegrass	*	
	Red Threeawn	*	
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Hoods Phlox	*	
	Rush Skeletonplant	*	10
	Scarlet Globemallow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1900 to 2100
Average	1650 to 1850
Unfavorable	1400 to 1600

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group

**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Silty Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		20
	Green Needlegrass		10
	Needleandthread		10
	Other Perennial Grasses		10
	Blue Grama		5
	Porcupinegrass		5
	Bearded Wheatgrass		5
	Big Bluestem	*	
	Prairie Dropseed	*	5
	Prairie Junegrass	*	
	Sideoats Grama	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Heath Aster	*	15
	Silverleaf Scurfpea	*	
	Stiff Sunflower	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Shrubs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	2800 to 3150
Average	2400 to 2750
Unfavorable	2000 to 2350

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Subirrigated Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Big Bluestem		40
	Switchgrass		20
	Prairie Cordgrass		5
	Little Bluestem		5
	Indiangrass	*	
	Northern Reedgrass	*	5
	Slender Wheatgrass	*	
	Western Wheatgrass	*	
	Canada Wildrye	*	
	Tall Dropseed	*	5
	Other Perennial Grasses	*	
	Fescue Sedge	*	
	Slim Sedge	*	5
	Woolly Sedge	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cinquefoil	*	
	Field Mint	*	
	Heath Aster	*	
	Maximillian Sunflower	*	10
	Tall Goldenrod	*	
	Tall White Aster	*	
	Other Sedges/Rushes	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	4350 to 4750
Average	3925 to 4325
Unfavorable	3500 to 3900

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.28 to 1.70
Good	0.85 to 1.28
Fair	0.43 to 0.85
Poor	0.10 to 0.43

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Subirrigated Sands Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Switchgrass		20
	Big Bluestem		15
	Porcupinegrass		5
	Prairie Cordgrass		5
	Bluejoint Reedgrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Sedge Species	*	25
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Maximillian Sunflower	*	
	Cudweed Sagewort	*	10
	Western Ragweed	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	
	Willow Species	*	10
	Spirea	*	
	Prairie Rose	*	
	Quaking Aspen		5

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3200 to 3700
Average	2600 to 3100
Unfavorable	2000 to 2500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Thin Claypan Range Site

Plant Community		
Characteristic Vegetation	Common Name	Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass	50
	Blue Grama	15
	Nuttall Alkaligrass	5
	Prairie Junegrass	5
	Alkali Muhly *	
	Green Needlegrass *	
	Inland Saltgrass *	5
	Needleandthread *	
	Sandberg Bluegrass *	
	Other Perennial Grasses *	
	Needleleaf Sedge *	
	Penn Sedge *	5
	Other Sedges/Rushes *	
Forbs (5% to 15% of Total)	Bladderpod *	
	Fringed Sagewort *	
	Lemon Scurfpea *	
	Rush Skeletonplant *	10
	Scarlet Globemallow *	
	Western Yarrow *	
	Other Perennial Forbs *	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed *	5
	Other Perennial Shrubs *	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1200 to 1300
Average	1000 to 1100
Unfavorable	800 to 900

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.30 to 0.40
Good	0.20 to 0.30
Fair	0.10 to 0.20
Poor	0.05 to 0.10

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Thin Sands Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Prairie Sandreed		25
	Little Bluestem		15
	Sideoats Grama		10
	Canada Wildrye		5
	Sand Bluestem		5
	Other Perennial Grasses		5
	Blue Grama	*	
	Green Needlegrass	*	
	Needleandthread	*	5
	Prairie Junegrass	*	
	Sand Dropseed	*	
	Western Wheatgrass	*	
	Needleleaf Sedge	*	10
	Penn Sedge	*	
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Groundcherry	*	
	Hairy Goldaster	*	15
	Lemon Scurfpea	*	
	Missouri Golderod	*	
	Prairie Spiderwort	*	
	Rush Skeletonplant	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Sand Cherry	*	10
	Woods Rose	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2200 to 2400
Average	1900 to 2100
Unfavorable	1700 to 1800

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Thin Upland Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Little Blustem		25
	Needleandthread		5
	Green Needlegrass		5
	Plains Muhly		5
	Porcupinegrass		5
	Prairie Dropseed		5
	Sideoats Grama		5
	Western Wheatgrass		5
	Other Perennial Grasses		5
	Blue Grama	*	
	Prairie Junegrass	*	Trace
	Prairie Sandreed	*	
	Red Threeawn	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Missouri Golderod	*	
	Pasqueflower	*	10
	Purple Coneflower	*	
	Purple Prairieclover	*	
	Stiff Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Silverberry	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2500 to 2800
Average	2150 to 2450
Unfavorable	1800 to 2100

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.68 to 0.90
Good	0.45 to 0.68
Fair	0.23 to 0.45
Poor	0.10 to 0.23

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Very Shallow Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		30
	Western Wheatgrass		10
	Blue Grama		10
	Bearded Wheatgrass		5
	Prairie Dropseed		5
	Prairie Junegrass		5
	Red Threeawn		5
	Plains Muhly	*	
	Red Threeawn	*	5
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Purple Prairieclover	*	10
	Rush Skeletonplant	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1100 to 1200
Average	900 to 1000
Unfavorable	800 to 900

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.30 to 0.40
Good	0.20 to 0.30
Fair	0.10 to 0.20
Poor	0.05 to 0.10

*Indicates the composition for species group
**Animal units per month

Table 12.—Range Site Descriptions--(continued)

Wet Meadow Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Northern Reedgrass		5
	Prairie Cordgrass		5
	Fowl Blue Grass	*	
	Mat Muhly	*	5
	Switchgrass	*	
	Other Perennial Grasses	*	
	Slim Sedge	*	70
	Woolly Sedge	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Fescue Sedge	*	
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Field Mint	*	
	Indian Hemp	*	
	Rydberg's Sunflower	*	10
	Tall Goldenrod	*	
	Tall White Aster	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	4500 to 4800
Average	4100 to 4400
Unfavorable	3700 to 4000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.35 to 1.80
Good	0.90 to 1.35
Fair	0.45 to 0.90
Poor	0.10 to 0.45

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions--(continued)

Wetland Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	American Mannagrass	*	
	American Slough Grass	*	
	Northern Reedgrass	*	5
	Prairie Cordgrass	*	
	Other Perennial Grasses	*	5
	Baltic Rush	*	
	Burreed	*	5
	Common Spikerush	*	
	Other Sedged/Rushes	*	
	Beaked Sedge	*	
	Slough Sedge	*	50
	Smooth-Cone Sedge	*	
	Water Sedge	*	
	Slim Sedge	*	5
	Woolly Sedge	*	
Forbs (5% to 15% of Total)	Longroot Smartweed	*	
	Mexican Dock	*	
	Waterparsnip	*	5
	Waterplaintain	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Sandbar Willow	*	Trace
	Willow Species	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	6600 to 7000
Average	6100 to 6500
Unfavorable	5600 to 6000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.95 to 2.60
Good	1.30 to 1.95
Fair	0.65 to 1.30
Poor	0.10 to 0.65

*Indicates the composition for species group
**Animal units per month

Recreation

Public areas in the survey area provide opportunities for numerous recreational activities, including: fishing, hiking, bird-watching, and hunting. For information on other recreational activities within the survey area contact the North Dakota State Department of Parks and Recreation.

Soils in the survey area are rated in Table 13, "Recreational Development," according to limitations affecting 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 location and accessibility of the area, size and shape of the area, and its scenic quality, ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and frequency of flooding is essential in planning recreational facilities.

Camp areas are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These 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. Soils are rated on the basis of soil properties that influence ease of developing camp areas and performance of the areas after development. Also considered are soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. Soils are rated on the basis of soil properties influencing cost of shaping the site, trafficability, and growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Playgrounds are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and can withstand heavy foot traffic and maintain an adequate cover of vegetation. Soils are rated on the basis of soil properties influencing the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Paths and trails are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. Soils are rated on the basis of soil properties influencing trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Interpretative ratings in Table 13 help engineers, planners, and others understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as **slight**, **moderate**, or **severe**.

Slight means soil properties are generally favorable for the rated use. Limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means soil properties are moderately favorable for the rated use. Limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than soils rated slight.

Severe means soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

Information in Table 13, "Recreational Development," can be supplemented by other information in this survey. For example, interpretations for dwellings without basements and for local roads and streets in Table 15, "Building Site Development," and interpretations for septic tank absorption fields in Table 16, "Sanitary Facilities," can supplement information obtained from Table 13.

Table 13.—Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--)indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
61:					
Arveson	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
118:					
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
Buse	Slight	Slight	Moderate: slope small stones	Slight	Slight
120:					
Barnes	Slight	Slight	Severe: slope	Slight	Slight
Buse	Slight	Slight	Slight: slope	Slight	Slight
156:					
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
Svea	Slight	Slight	Moderate: slope small stones	Slight	Slight
167:					
Bearden	Moderate: wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
296:					
Brantford	Slight	Slight	Moderate: small stones	Slight	Moderate: droughty
314:					
Buse	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Barnes	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
319:					
Buse	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Barnes	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
391:					
Cavour	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Cresbard	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
450:					
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
511:					
Divide	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness
536:					
Eckman	Slight	Slight	Severe: slope	Slight	Slight
Zell	Slight	Slight	Severe: slope	Slight	Slight
539:					
Edgeley	Slight	Slight	Slight	Slight	Moderate: depth to rock
541:					
Edgeley	Slight	Slight	Moderate: slope depth to rock	Slight	Moderate: depth to rock
569:					
Embden	Slight	Slight	Slight	Slight	Slight
579:					
Embden	Slight	Slight	Moderate: slope	Slight	Slight
Egeland	Slight	Slight	Moderate: slope	Slight	Slight
595:					
Emrick	Slight	Slight	Slight	Slight	Slight
Cathay	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
597:					
Emrick	Slight	Slight	Slight	Slight	Slight
Heimdal	Slight	Slight	Slight	Slight	Slight

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
605:					
Esmond	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Heimdal	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
753:					
Fram	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Wyard	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness
769:					
Gardena	Slight	Slight	Slight	Slight	Slight
773:					
Gardena	Slight	Slight	Moderate: slope	Slight	Slight
Eckman	Slight	Slight	Moderate: slope	Slight	Slight
881:					
Hamerly	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
884:					
Hamerly	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Wyard	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness
893:					
Harriet	Severe: flooding percs slowly wetness	Severe: excess sodium percs slowly wetness	Severe: percs slowly wetness	Severe: wetness	Severe: excess sodium wetness
988:					
Heimdal	Slight	Slight	Moderate: slope	Slight	Slight
Emrick	Slight	Slight	Moderate: slope	Slight	Slight
998:					
Heimdal	Slight	Slight	Severe: slope	Slight	Slight

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
998:(con't)					
Esmond	Slight	Slight	Severe: slope	Slight	Slight
1001:					
Heimdal	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Esmond	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
1015:					
Kensal	Slight	Slight	Slight	Slight	Slight
1062:					
LaDelle	Severe: flooding	Slight	Moderate: flooding	Slight	Moderate: flooding
1108:					
Larson	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Cathay	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
1188:					
Ludden	Severe: flooding too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding	Severe: too clayey ponding
1189:					
Ludden, saline	Severe: flooding too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness	Severe: too clayey wetness
1221:					
Maddock	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
Hecla	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
1267:					
Marysland	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1268:					
Marysland, wet	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1427:					
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1454:					
Wyndmere	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
1466:					
Pits, sand and gravel	Severe: slope small stones	Severe: slope too sandy	Severe: slope small stones	Severe: slope too sandy	Severe: slope small stones
1710:					
Southam	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1762:					
Svea	Slight	Slight	Moderate: small stones	Slight	Slight
Barnes	Slight	Slight	Moderate: small stones	Slight	Slight
1765:					
Svea	Slight	Slight	Moderate: slope small stones	Slight	Slight
Buse	Slight	Slight	Moderate: slope small stones	Slight	Slight
1766:					
Svea	Slight	Slight	Severe: slope	Slight	Slight
Buse	Slight	Slight	Severe: slope	Slight	Slight
1769:					
Svea	Slight	Slight	Moderate: small stones	Slight	Slight
Cresbard	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
1781:					
Swenoda	Slight	Slight	Slight	Slight	Slight
1843:					
Towner	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
1883:					
Vallers	Severe: wetness	Moderate: percs slowly wetness	Severe: wetness	Moderate: wetness	Moderate: wetness

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1883:(con't)					
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1886:					
Hamerly, saline	Severe: excess salt	Severe: excess salt	Severe: excess salt	Moderate: wetness	Severe: excess salt
Vallers, saline	Severe: excess salt wetness	Severe: excess salt wetness	Severe: excess salt wetness	Severe: wetness	Severe: excess salt wetness
1970:					
Walum	Slight	Slight	Slight	Slight	Moderate: droughty
1978:					
Water	---	---	---	---	---
2118:					
Fram	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
2121:					
Ferney	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
2151:					
Binford	Slight	Slight	Moderate: slope	Slight	Moderate: droughty
Coe	Slight	Slight	Moderate: slope	Slight	Severe: droughty
2152:					
Coe	Severe: slope small stones	Severe: slope small stones	Severe: slope small stones	Moderate: slope	Severe: slope small stones droughty
Binford	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope droughty
2153:					
Edgeley	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Kloten	Severe: area reclaim slope thin layer	Severe: area reclaim slope thin layer	Severe: area reclaim slope thin layer	Moderate: slope	Severe: area reclaim slope thin layer
Esmond	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2156:					
Lamoure	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness
Rauville	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness	Severe: wetness	Severe: flooding wetness
2157:					
Maddock	Moderate: slope too sandy	Moderate: slope too sandy	Severe: slope	Moderate: too sandy	Moderate: slope droughty
Esmond	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Embden	Slight	Slight	Severe: slope	Slight	Slight
2158:					
Velva	Severe: flooding	Slight	Moderate: flooding slope	Slight	Moderate: flooding
2159:					
Walsh	Slight	Slight	Moderate: slope small stones	Slight	Slight
2196:					
Bearden, saline	Severe: excess salt	Severe: excess salt	Severe: excess salt	Moderate: wetness	Severe: excess salt
Colvin, saline	Severe: excess salt wetness	Severe: excess salt wetness	Severe: excess salt wetness	Severe: wetness	Severe: excess salt wetness
2197:					
Edgeley	Slight	Slight	Severe: slope	Slight	Moderate: depth to rock
Kloten	Severe: area reclaim thin layer	Severe: area reclaim thin layer	Severe: area reclaim slope thin layer	Slight	Severe: area reclaim thin layer
2198:					
Hamar	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness droughty
Hecla	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: droughty
2199:					
Hamerly	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: large stones wetness	Moderate: wetness	Moderate: large stones

Table 13.—Recreational Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,""moderate,""severe." Dashes (--) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2199(con't):					
Barnes	Slight	Slight	Severe: large stones	Slight	Moderate: large stones
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
2200:					
Letcher	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Swenoda	Slight	Slight	Slight	Slight	Slight
2201:					
Stirum	Severe: excess sodium ponding	Severe: excess sodium ponding	Severe: excess sodium ponding	Severe: ponding	Severe: excess sodium ponding
Arveson, saline	Severe: excess salt wetness	Severe: excess salt wetness	Severe: excess salt wetness	Severe: wetness	Severe: excess salt wetness
2202:					
Swenoda	Slight	Slight	Moderate: slope	Slight	Slight
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
2203:					
Swenoda	Slight	Slight	Severe: slope	Slight	Slight
Barnes	Slight	Slight	Severe: slope	Slight	Slight
2204:					
Walsh	Slight	Slight	Severe: slope	Slight	Slight
2205:					
Zell	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Eckman	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife for food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing existing plant cover, and fostering the natural establishment of desirable plants.

On Table 14, "Wildlife Habitat," 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. It can also be used for selecting soils 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 for wildlife habitat is rated **good, fair, poor** or **very poor**. A rating of **good** indicates the 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 the kind of wildlife habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of **poor** indicates limitations are severe for the designated 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 restrictions for the element or kind of wildlife habitat are very severe and unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat shown on Table 14 are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are wheat, rye, oats, corn, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are bromegrass, intermediate wheatgrass, tall wheatgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, goldenrod, blue grama, switchgrass, Maximilian sunflower, and western wheatgrass.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity or sodicity, and flooding. The length of the growing season also is important.

Hardwood trees produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, boxelder, green ash, willow, and American elm.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that provide habitat or supply food in the form of browse, seed, or fruitlike cones. Examples are pine, spruce, cedar, and juniper.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of root zone, the amount of water available to plants, and wetness.

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 rooting zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, juneberry, hawthorn, American plum, and redosier dogwood.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweed, sedges, bulrushes, white top, common reedgrass, saltgrass, prairie cordgrass, and cattail.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and saturated hydraulic conductivity.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, pheasant, sharptail grouse, meadowlark, lark bunting, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy, shallow water areas that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. The wildlife attracted to rangeland include deer, sharptailed grouse, western meadowlark, and David's sparrow.

Table 14.—Wildlife Habitat

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
61:												
Arveson	Poor	Fair	Fair	---	---	Fair	Good	Good	Fair	---	Good	Fair
118:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Buse	Fair	Good	Fair	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
120:												
Barnes	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Buse	Fair	Good	Fair	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
156:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Svea	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
167:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
296:												
Brantford	Fair	Fair	Good	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Very	Fair
314:												
Buse	Poor	Fair	Fair	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
Barnes	Fair	Good	Good	Good	Good	Fair	Very poor	Very poor	Good	Good	Very poor	Fair
319:												
Buse	Very poor	Very poor	Fair	---	---	Fair	Very poor	Very poor	Poor	---	Very poor	Fair
Barnes	Poor	Fair	Good	Good	Good	Fair	Very poor	Very poor	Fair	Good	Very poor	Fair

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
391:												
Cavour	Poor	Poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor
Cresbard	Good	Fair	Good	Fair	Very poor	Poor	Very poor	Very poor	Good	Very poor	Very poor	Good
450:												
Colvin	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	Fair
511:												
Divide	Fair	Fair	Good	Good	Good	Fair	Fair	Very poor	Fair	Good	Poor	Fair
536:												
Eckman	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Zell	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
539:												
Edgeley	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Very poor	Fair
541:												
Edgeley	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Very poor	Fair
569:												
Embden	Fair	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
579:												
Embden	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Egeland	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
595:												
Emrick	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair
Cathay	Fair	Good	Good	---	---	Poor	Poor	Poor	Fair	---	Poor	Fair
597:												
Emrick	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair
Heimdal	Good	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
605:												
Esmond	Poor	Fair	Good	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
Heimdal	Poor	Fair	Good	---	---	Fair	Poor	Very poor	Fair	---	Very poor	Fair
753:												
Fram	Good	Good	Good	---	---	Fair	Fair	Poor	Good	---	Poor	Fair
Wyard	Good	Good	Good	---	---	Good	Fair	Fair	Good	---	Fair	Good
769:												
Gardena	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
773:												
Gardena	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Eckman	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
881:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Tonka	Poor	Fair	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
884:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Wyard	Good	Good	Good	---	---	Good	Fair	Fair	Good	---	Fair	Good
893:												
Harriet	Poor	Poor	Fair	Poor	Poor	Very poor	Good	Good	Poor	Poor	Good	Poor
988:												
Heimdal	Good	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
Emrick	Good	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
998:												
Heimdal	Fair	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
Esmond	Fair	Good	Good	---	---	Fair	Poor	Very poor	Good	---	Very poor	Fair
1001:												
Heimdal	Poor	Fair	Good	---	---	Fair	Poor	Very poor	Fair	---	Very poor	Fair

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
1001:(con't)												
Esmond	Very poor	Very poor	Good	---	---	Fair	Very poor	Very poor	Poor	---	Very poor	Fair
1015:												
Kensal	Fair	Fair	Fair	---	---	Poor	Poor	Poor	Fair	---	Very poor	Poor
1062:												
LaDelle	Good	Good	Fair	---	---	Good	Very poor	Very poor	Good	---	Very poor	Fair
1108:												
Larson	Poor	Poor	Poor	---	---	Very poor	Poor	Poor	Poor	---	Poor	Very poor
Cathay	Fair	Good	Good	---	---	Poor	Poor	Poor	Fair	---	Poor	Fair
1188:												
Ludden	Fair	Fair	Good	---	---	Good	Poor	Good	Fair	---	Fair	Good
1189:												
Ludden, saline	Fair	Fair	Very poor	---	---	Very poor	Good	Good	Fair	---	Good	Very poor
1221:												
Maddock	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor	Fair
Hecla	Fair	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair
1267:												
Marysland	Poor	Fair	Fair	---	---	Fair	Good	Good	Fair	---	Good	Fair
1268:												
Marysland, wet	Very poor	Poor	Poor	---	---	Poor	Good	Good	Poor	---	Good	Poor
1427:												
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
1454:												
Wyndmere	Fair	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
1466:												
Pits, sand and gravel	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
1710:												
Southam	Very poor	Very poor	Very poor	---	---	Very poor	Good	Good	Very poor	---	Good	Very poor

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1762:												
Svea	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
1765:												
Svea	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Buse	Fair	Good	Fair	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
1766:												
Svea	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Fair	Good	Very poor	Fair
Buse	Fair	Good	Fair	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
1769:												
Svea	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good
Cresbard	Good	Fair	Good	Fair	Very poor	Poor	Very poor	Very poor	Good	Very poor	Very poor	Good
1781:												
Swenoda	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
1843:												
Towner	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
1883:												
Vallers	Poor	Fair	Fair	---	---	Fair	Good	Good	Fair	---	Good	Fair
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
1886:												
Hamerly, saline	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Fair
Vallers, saline	Poor	Fair	Very poor	---	---	Very poor	Good	Good	Poor	---	Good	Very poor
1970:												
Walum	Fair	Good	Good	---	---	Fair	Fair	Very poor	Fair	---	Poor	Fair

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1978:												
Water	---	---	---	---	---	---	---	---	---	---	---	---
2118:												
Fram	Good	Good	Good	---	---	Fair	Fair	Poor	Good	---	Poor	Fair
Tonka	Poor	Fair	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
2121:												
Ferney	Poor	Poor	Very poor	Poor	Very poor	Very poor	Poor	Poor	Poor	Poor	Poor	Very poor
2151:												
Binford	Fair	Good	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Fair	Very poor	Poor
Coe	Poor	Poor	Fair	---	---	Poor	Very poor	Very poor	Poor	---	Very poor	Fair
2152:												
Coe	Very poor	Poor	Fair	---	---	Poor	Very poor	Very poor	Poor	---	Very poor	Fair
Binford	Fair	Good	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Fair	Very poor	Poor
2153:												
Edgeley	Poor	Fair	Good	Good	Good	Fair	Very poor	Very poor	Fair	Good	Very poor	Fair
Kloten	Very poor	Very poor	Fair	Poor	Poor	Fair	Very poor	Very poor	Poor	Poor	Very poor	Fair
Esmond	Very poor	Very poor	Good	---	---	Fair	Very poor	Very poor	Poor	---	Very poor	Fair
2156:												
Lamoure	Poor	Fair	Fair	---	---	Fair	Good	Good	Fair	---	Good	Fair
Rauville	Very poor	Poor	Fair	Poor	Very poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair
2157:												
Maddock	Poor	Fair	Good	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor	Fair
Esmond	Poor	Fair	Good	---	---	Fair	Very poor	Very poor	Fair	---	Very poor	Fair
Embden	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2158:												
Velva	Fair	Good	Fair	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor	Fair
2159:												
Walsh	Good	Good	Fair	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2196:												
Bearden, saline	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Poor
Colvin, saline	Poor	Fair	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	Poor
2197:												
Edgeley	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Kloten	Poor	Poor	Fair	Poor	Poor	Fair	Poor	Very poor	Poor	Poor	Very poor	Fair
2198:												
Hamar	Fair	Good	Good	Fair	Fair	Fair	Fair	Very poor	Good	Fair	Poor	Fair
Hecla	Fair	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair
2199:												
Hamerly	Poor	Poor	Good	Good	Good	Fair	Poor	Very poor	Poor	Good	Very poor	Fair
Barnes	Poor	Poor	Good	Good	Good	Fair	Poor	Very poor	Poor	Good	Very poor	Fair
Tonka	Poor	Fair	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
2200:												
Letcher	Poor	Poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor
Swenoda	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
2201:												
Stirum	Very poor	Very poor	Very poor	Poor	Poor	Fair	Good	Fair	Very poor	Poor	Fair	Poor
Arveson, saline	Poor	Fair	Very poor	---	---	Very poor	Good	Good	Poor	---	Good	Very poor

Table 14.—Wildlife Habitat--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair", "poor" and "very poor." Dashes (--) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life	Range-land wild-life
2202:												
Swenoda	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2203:												
Swenoda	Fair	Good	Good	---	---	Fair	Very poor	Very poor	Good	---	Very poor	Fair
Barnes	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2204:												
Walsh	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor	Fair	Good	Very poor	Fair
2205:												
Zell	Very poor	Very poor	Good	---	---	Fair	Very poor	Very poor	Poor	---	Very poor	Fair
Eckman	Fair	Good	Good	Good	Good	Fair	Very poor	Very poor	Good	Good	Very poor	Fair

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. Ratings are given for 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 should 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 or 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 15,"Building Site Development," shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered **slight** if soil properties and site features generally are 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 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 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 generally are 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, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 16, "Sanitary Facilities," shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as a daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of **slight, moderate,** or **severe** are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of **good, fair,** and **poor** are given for daily cover for landfill.

A rating of **slight** or **good** indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of **moderate** or **fair** indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of **severe** or **poor** indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

Septic tank absorption fields are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

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, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively impervious soil material for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

Table 16, "Sanitary Facilities" 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 resulting from rapid permeability in 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.

Trench sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

Area sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in Table 16, "Sanitary Facilities" 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 sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock 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.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Construction Materials

Table 17, "Construction Materials" 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.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In Table 17, "Construction Materials," 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. Table 19, “Engineering Index Properties,” provides detailed information about each soil layer. This information can help to 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, a 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 a 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 one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, slopes of more than 25 percent, or a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In Table 17, "Construction Materials," only the probability of finding material in suitable quantity in or below the soil 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 (Table 19).

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 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. 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 high water table at or near the surface.

The surface layer of most soils generally is 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 18, "Water Management," 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; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered **slight** if soil properties and site features generally are 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 Table 18, "Water Management," 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 more 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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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 the potential for 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 control 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.

Table 15.—Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
61:						
Arveson	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
118:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
120:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
156:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell slope	Severe: low strength	Slight
167:						
Bearden	Severe: wetness	Moderate: shrink-swell wetness	Severe: shrink-swell wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Moderate: wetness
296:						
Brantford	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
314:						
Buse	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: slope	Severe: low strength	Moderate: slope
Barnes	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: slope	Severe: low strength	Moderate: slope
319:						
Buse	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Barnes	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
391:						
Cavour	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: low strength shrink-swell	Severe: excess sodium
Cresbard	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: low strength shrink-swell	Severe: excess sodium
450:						
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: wetness
511:						
Divide	Severe: wetness cutbanks cave	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: frost action wetness	Moderate: wetness
536:						
Eckman	Slight	Slight	Slight	Moderate: slope	Severe: frost action	Slight
Zell	Slight	Slight	Slight	Moderate: slope	Severe: frost action	Slight
539:						
Edgeley	Moderate: depth to rock	Moderate: shrink-swell	Moderate: shrink-swell depth to rock	Moderate: shrink-swell	Severe: low strength	Moderate: depth to rock
541:						
Edgeley	Moderate: depth to rock	Moderate: shrink-swell	Moderate: shrink-swell depth to rock	Moderate: shrink-swell slope	Severe: low strength	Moderate: depth to rock
569:						
Embden	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight
579:						
Embden	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight
Egeland	Severe: cutbanks cave	Slight	Slight	Slight	Moderate: frost action	Slight
595:						
Emrick	Slight	Slight	Slight	Slight	Moderate: frost action	Slight
Cathay	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
597:						
Emrick	Slight	Slight	Slight	Slight	Moderate: frost action	Slight
Heimdal	Slight	Slight	Slight	Slight	Moderate: frost action	Slight
605:						
Esmond	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
Heimdal	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
753:						
Fram	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Slight
Wyard	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
769:						
Gardena	Moderate: wetness	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
773:						
Gardena	Moderate: wetness	Slight	Moderate: wetness	Moderate: slope	Severe: frost action	Slight
Eckman	Slight	Slight	Slight	Moderate: slope	Severe: frost action	Slight
881:						
Hamerly	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action	Moderate: wetness
Tonka	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
884:						
Hamerly	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action	Moderate: wetness
Wyard	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
893:						
Harriet	Severe: wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: excess sodium wetness

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
988:						
Heimdal	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
Emrick	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
998:						
Heimdal	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
Esmond	Slight	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
1001:						
Heimdal	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
1015:						
Kensal	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Severe: frost action	Slight
1062:						
LaDelle	Moderate: flooding wetness	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding frost action low strength	Moderate: flooding
1108:						
Larson	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Moderate: frost action low strength shrink-swell	Severe: excess sodium
Cathay	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium
1188:						
Ludden	Severe: ponding cutbanks cave	Severe: flooding shrink-swell ponding	Severe: flooding shrink-swell ponding	Severe: flooding shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: too clayey ponding
1189:						
Ludden, saline	Severe: wetness cutbanks cave	Severe: flooding shrink-swell wetness	Severe: flooding shrink-swell wetness	Severe: flooding shrink-swell wetness	Severe: low strength shrink-swell wetness	Severe: too clayey wetness
1221:						
Maddock	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1221:(con't)						
Hecla	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
1267:						
Marysland	Severe: wetness, cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action, wetness	Severe: wetness
1268:						
Marysland, wet	Severe: ponding, cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: frost action, ponding	Severe: ponding
1427:						
Parnell	Severe: excess humus, ponding	Severe: shrink-swell, ponding	Severe: shrink-swell, ponding	Severe: shrink-swell, ponding	Severe: low strength, shrink-swell, ponding	Severe: ponding
1454:						
Wyndmere	Severe: wetness, cutbanks cave	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Slight
1466:						
Pits, sand and gravel	Severe: slope, cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, small stones, droughty
1710:						
Southam	Severe: ponding	Severe: shrink-swell, ponding	Severe: shrink-swell, ponding	Severe: shrink-swell, ponding	Severe: low strength, shrink-swell, ponding	Severe: ponding
1762:						
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell, wetness	Moderate: shrink-swell	Severe: low strength	Slight
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
1765:						
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell, wetness	Moderate: shrink-swell, slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength	Slight

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1766:						
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
1769:						
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Slight
Cresbard	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength shrink-swell	Severe: excess sodium
1781:						
Swenoda	Moderate: wetness	Slight	Moderate: shrink-swell wetness	Slight	Moderate: frost action	Slight
1843:						
Towner	Severe: cutbanks cave	Slight	Moderate: shrink-swell wetness	Slight	Moderate: frost action	Moderate: droughty
1883:						
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
Parnell	Severe: excess humus ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Moderate: ponding
1886:						
Hamerly, saline	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Severe: excess salt
Vallers, saline	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action low strength wetness	Severe: excess salt wetness
1970:						
Walum	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Slight	Moderate: droughty
1978:						
Water	---	---	---	---	---	---
2118:						
Fram	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Slight

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2118:(con't)						
Tonka	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
2121:						
Ferney	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Moderate: low strength shrink-swell wetness	Severe: excess sodium
2151:						
Binford	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Coe	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe: droughty
2152:						
Coe	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope small stones droughty
Binford	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope droughty
2153:						
Edgeley	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Kloten	Severe: slope depth to rock	Severe: slope	Severe: slope depth to rock	Severe: slope	Severe: slope	Severe: area reclaim slope
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
2156:						
Lamoure	Severe: wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: flooding wetness
Rauville	Severe: wetness cutbanks cave	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: flooding wetness
2157:						
Maddock	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope droughty

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2157:(con't)						
Esmond	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope
Embden	Severe: cutbanks cave	Slight	Slight	Moderate: slope	Moderate: frost action	Slight
2158:						
Velva	Moderate: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding
2159:						
Walsh	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
2196:						
Bearden, saline	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action low strength	Severe: excess salt
Colvin, saline	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: low strength wetness	Severe: excess salt wetness
2197:						
Edgeley	Moderate: depth to rock	Moderate: shrink-swell	Moderate: shrink-swell depth to rock	Moderate: shrink-swell slope	Severe: low strength	Moderate: depth to rock
Kloten	Severe: depth to rock	Moderate: shrink-swell	Severe: depth to rock	Moderate: shrink-swell slope	Moderate: low strength shrink-swell	Severe: area reclaim thin layer
2198:						
Hamar	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Moderate: frost action wetness	Moderate: wetness droughty
Hecla	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
2199:						
Hamerly	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action	Moderate: large stones
Barnes	Slight	Slight	Slight	Slight	Moderate: frost action low strength	Moderate: large stones
Tonka	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding

Table 15.—Building Site Development--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2200:						
Letcher	Moderate: wetness	Slight	Moderate: wetness	Slight	Moderate: frost action	Severe: excess sodium
Swenoda	Moderate: wetness	Slight	Moderate: shrink-swell wetness	Slight	Moderate: frost action	Slight
2201:						
Stirum	Severe: ponding cutbanks cave	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: excess sodium ponding
Arveson, saline	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: excess salt wetness
2202:						
Swenoda	Moderate: wetness	Slight	Moderate: shrink-swell wetness	Moderate: slope	Moderate: frost action	Slight
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Moderate: low strength shrink-swell	Slight
2203:						
Swenoda	Moderate: wetness	Slight	Moderate: shrink-swell wetness	Moderate: slope	Moderate: frost action	Slight
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Moderate: low strength shrink-swell	Slight
2204:						
Walsh	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
2205:						
Zell	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: frost action slope	Severe: slope
Eckman	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Severe: frost action	Moderate: slope

Table 16.—Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
61:					
Arveson	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
118:					
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Buse	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
120:					
Barnes	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Buse	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
156:					
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Svea	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
167:					
Bearden	Severe: percs slowly wetness	Severe: wetness	Severe: too clayey wetness	Severe: wetness	Poor: hard to pack too clayey
296:					
Brantford	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
314:					
Buse	Severe: percs slowly	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
Barnes	Severe: percs slowly	Severe: slope	Moderate: slope too clayey	Moderate: slope	Fair: slope too clayey
319:					
Buse	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Barnes	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
391:					
Cavour	Severe: percs slowly	Slight	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium hard to pack
Cresbard	Severe: percs slowly	Moderate: wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium hard to pack
450:					
Colvin	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
511:					
Divide	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage small stones too sandy
536:					
Eckman	Moderate: percs slowly	Severe: slope	Slight	Slight	Good
Zell	Moderate: percs slowly	Severe: slope	Slight	Slight	Good
539:					
Edgeley	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Poor: hard to pack depth to rock
541:					
Edgeley	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Poor: hard to pack depth to rock
569:					
Embden	Severe: wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Fair: too sandy wetness
579:					
Embden	Severe: wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Fair: too sandy wetness
Egeland	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy
595:					
Emrick	Moderate: percs slowly	Moderate: seepage	Slight	Slight	Good
Cathay	Severe: percs slowly wetness	Severe: wetness	Severe: excess sodium wetness	Severe: wetness	Poor: excess sodium
597:					
Emrick	Moderate: percs slowly	Moderate: seepage	Slight	Slight	Good

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
597:(con't)					
Heimdal	Moderate: percs slowly	Moderate: seepage	Slight	Slight	Good
605:					
Esmond	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
Heimdal	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
753:					
Fram	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness
Wyard	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
769:					
Gardena	Severe: wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Fair: wetness
773:					
Gardena	Severe: wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Fair: wetness
Eckman	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
881:					
Hamerly	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
884:					
Hamerly	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Wyard	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
893:					
Harriet	Severe: flooding percs slowly wetness	Severe: flooding	Severe: flooding too clayey wetness	Severe: flooding wetness	Poor: hard to pack too clayey wetness

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
988:					
Heimdal	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
Emrick	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Good
998:					
Heimdal	Moderate: percs slowly	Severe: slope	Slight	Slight	Good
Esmond	Moderate: percs slowly	Severe: slope	Slight	Slight	Good
1001:					
Heimdal	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
1015:					
Kensal	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage small stones too sandy
1062:					
LaDelle	Severe: flooding percs slowly	Severe: flooding	Severe: flooding wetness	Severe: flooding	Fair: too clayey
1108:					
Larson	Severe: percs slowly wetness	Severe: wetness	Severe: excess sodium wetness	Severe: wetness	Poor: excess sodium
Cathay	Severe: percs slowly wetness	Severe: wetness	Severe: excess sodium wetness	Severe: wetness	Poor: excess sodium
1188:					
Ludden	Severe: flooding percs slowly ponding	Severe: flooding ponding	Severe: flooding too clayey ponding	Severe: flooding ponding	Poor: too clayey ponding
1189:					
Ludden, saline	Severe: flooding percs slowly wetness	Severe: flooding	Severe: flooding too clayey wetness	Severe: flooding wetness	Poor: hard to pack too clayey wetness

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1221:					
Maddock	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage too sandy
Hecla	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
1267:					
Marysland	Severe: percs slowly wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Poor: seepage small stones too sandy
1268:					
Marysland, wet	Severe: ponding poor filter	Severe: seepage ponding	Severe: seepage too sandy ponding	Severe: seepage ponding	Poor: seepage too sandy ponding
1427:					
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey
1454:					
Wyndmere	Severe: percs slowly wetness	Severe: seepage wetness	Severe: too sandy wetness	Severe: seepage wetness	Poor: too sandy
1466:					
Pits, sand and gravel	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy
1710:					
Southam	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1762:					
Svea	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Barnes	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey
1765:					
Svea	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Buse	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1766:					
Svea	Severe: percs slowly wetness	Severe: slope wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Buse	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
1769:					
Svea	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Cresbard	Severe: percs slowly	Moderate: wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium hard to pack
1781:					
Swenoda	Severe: percs slowly wetness	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
1843:					
Towner	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
1883:					
Vallers	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1886:					
Hamerly, saline	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Vallers, saline	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
1970:					
Walum	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: too sandy
1978:					
Water	---	---	---	---	---
2118:					
Fram	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: wetness

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2118:(con't)					
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
2121:					
Ferney	Severe: percs slowly wetness	Slight	Severe: excess sodium wetness	Severe: wetness	Poor: excess sodium
2151:					
Binford	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
Coe	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones
2152:					
Coe	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy
Binford	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones
2153:					
Edgeley	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Poor: hard to pack slope depth to rock
Kloten	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Poor: area reclaim slope depth to rock
Esmond	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
2156:					
Lamoure	Severe: flooding percs slowly wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Poor: wetness
Rauville	Severe: flooding percs slowly wetness	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Severe: flooding wetness	Poor: hard to pack too clayey wetness

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2157:					
Maddock	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: seepage too sandy
Esmond	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope
Embden	Slight	Severe: seepage slope	Severe: seepage	Severe: seepage	Fair: too sandy
2158:					
Velva	Severe: flooding	Severe: flooding seepage	Severe: flooding seepage	Severe: flooding seepage	Good
2159:					
Walsh	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Poor: hard to pack
2196:					
Bearden, saline	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Colvin, saline	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
2197:					
Edgeley	Severe: depth to rock	Severe: slope depth to rock	Severe: depth to rock	Severe: depth to rock	Poor: hard to pack depth to rock
Kloten	Severe: seepage thin layer depth to rock	Severe: seepage slope depth to rock	Severe: seepage depth to rock	Severe: seepage depth to rock	Poor: area reclaim thin layer depth to rock
2198:					
Hamar	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
Hecla	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy
2199:					
Hamerly	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness

Table 16.—Sanitary Facilities--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2199:(con't)					
Barnes	Severe: percs slowly	Moderate: large stones seepage slope	Moderate: too clayey	Slight	Fair: large stones too clayey
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
2200:					
Letcher	Severe: wetness	Severe: seepage	Severe: excess sodium seepage	Severe: seepage	Poor: excess sodium
Swenoda	Severe: percs slowly wetness	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
2201:					
Stirum	Severe: ponding poor filter	Severe: seepage ponding	Severe: seepage ponding	Severe: seepage ponding	Poor: excess sodium ponding
Arveson, saline	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: seepage too sandy wetness
2202:					
Swenoda	Severe: percs slowly wetness	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
2203:					
Swenoda	Severe: percs slowly wetness	Severe: seepage slope wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
Barnes	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
2204:					
Walsh	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Poor: hard to pack
2205:					
Zell	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Eckman	Moderate: percs slowly slope	Severe: slope	Moderate: slope	Moderate: slope	Fair: slope

Table 17.—Construction Materials

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
61:				
Arveson	Poor: wetness	Probable	Improbable: too sandy	Poor: wetness
118:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
120:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too stony
156:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
167:				
Bearden	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
296:				
Brantford	Good	Probable	Probable	Poor: area reclaim small stones too sandy
314:				
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones too clayey
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones
319:				
Buse	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: slope
391:				
Cavour	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
391:(con't)				
Cresbard	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium too clayey
450:				
Colvin	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
511:				
Divide	Fair: wetness	Probable	Probable	Poor: area reclaim small stones too sandy
536:				
Eckman	Good	Improbable: excess fines	Improbable: excess fines	Good
Zell	Good	Improbable: excess fines	Improbable: excess fines	Good
539:				
Edgeley	Poor: low strength depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: small stones
541:				
Edgeley	Poor: low strength depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: small stones
569:				
Embden	Good	Improbable: excess fines	Improbable: excess fines	Good
579:				
Embden	Good	Improbable: excess fines	Improbable: excess fines	Good
Egeland	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
595:				
Emrick	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Cathay	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
597:				
Emrick	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
605:				
Esmond	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope
753:				
Fram	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Wyard	Fair: shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: area reclaim small stones
769:				
Gardena	Good	Improbable: excess fines	Improbable: excess fines	Good
773:				
Gardena	Good	Improbable: excess fines	Improbable: excess fines	Good
Eckman	Good	Improbable: excess fines	Improbable: excess fines	Good
881:				
Hamerly	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
884:				
Hamerly	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Wyard	Fair: shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: area reclaim small stones
893:				
Harriet	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt too clayey wetness
988:				
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Emrick	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
998:				
Heimdal	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Esmond	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1001:				
Heimdal	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Esmond	Poor: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
1015:				
Kensal	Good	Probable	Probable	Poor: area reclaim small stones
1062:				
LaDelle	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good
1108:				
Larson	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
Cathay	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
1188:				
Ludden	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1189:				
Ludden, saline	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1221:				
Maddock	Good	Probable	Improbable: too sandy	Poor: too sandy
Hecla	Good	Probable	Improbable: too sandy	Poor: too sandy
1267:				
Marysland	Poor: wetness	Probable	Probable	Poor: area reclaim small stones wetness

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1268:				
Marysland, wet	Poor: wetness	Probable	Probable	Poor: wetness
1427:				
Parnell	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1454:				
Wyndmere	Fair: thin layer wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
1466:				
Pits, sand and gravel	Poor: slope	Probable	Probable	Poor: area reclaim small stones too sandy
1710:				
Southam	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1762:				
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1765:				
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
1766:				
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
1769:				
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Cresbard	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium too clayey

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1781:				
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1843:				
Towner	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
1883:				
Vallers	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Parnell	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1886:				
Hamerly, saline	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess salt
Vallers, saline	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt wetness
1970:				
Walum	Good	Probable	Probable	Poor: area reclaim too sandy
1978:				
Water	---	---	---	---
2118:				
Fram	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
2121:				
Ferney	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium excess salt
2151:				
Binford	Good	Probable	Probable	Poor: area reclaim small stones too sandy

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2151:(con't)				
Coe	Good	Probable	Probable	Poor: area reclaim small stones too sandy
2152:				
Coe	Fair: slope	Probable	Probable	Poor: area reclaim small stones too sandy
Binford	Good	Probable	Probable	Poor: area reclaim small stones too sandy
2153:				
Edgeley	Poor: low strength depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: slope small stones
Kloten	Poor: area reclaim thin layer depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: area reclaim slope depth to rock
Esmond	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
2156:				
Lamoure	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Rauville	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
2157:				
Maddock	Good	Probable	Improbable: too sandy	Poor: too sandy
Esmond	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope small stones
Embden	Good	Improbable: excess fines	Improbable: excess fines	Good
2158:				
Velva	Good	Improbable: excess fines	Improbable: excess fines	Good
2159:				
Walsh	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2196:				
Bearden, saline	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt wetness
Colvin, saline	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess salt
2197:				
Edgeley	Poor: low strength depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: small stones
Kloten	Poor: area reclaim thin layer depth to rock	Improbable: excess fines	Improbable: excess fines	Poor: area reclaim depth to rock
2198:				
Hamar	Fair: wetness	Probable	Improbable: too sandy	Poor: too sandy
Hecla	Good	Probable	Improbable: too sandy	Poor: too sandy
2199:				
Hamerly	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: area reclaim large stones
Barnes	Fair: low strength	Improbable: excess fines	Improbable: excess fines	Poor: large stones
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
2200:				
Letcher	Good	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
2201:				
Stirum	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium excess salt wetness
Arveson, saline	Poor: wetness	Probable	Improbable: too sandy	Poor: excess salt wetness

Table 17.—Construction Materials--(continued)

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (--) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2202:				
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Barnes	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2203:				
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Barnes	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2204:				
Walsh	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
2205:				
Zell	Fair: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Eckman	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope

Table 18.—Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
61:							
Arveson	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Limitation: frost action cutbanks cave	Limitation: wetness soil blowing	Limitation: too sandy wetness soil blowing	Limitation: wetness
118:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Buse	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
120:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Buse	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
156:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Svea	Moderate: seepage slope	Severe: piping	Severe: slow refill	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
167:							
Bearden	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: frost action percs slowly	Limitation: wetness	Limitation: erodes easily percs slowly wetness	Limitation: erodes easily percs slowly
296:							
Brantford	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: droughty	Limitation: large stones too sandy	Limitation: large stones droughty
314:							
Buse	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Barnes	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
319:							
Buse	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Limitations for— Embankments, dikes, and levees	Limitations for— Aquifer-fed excavated ponds	Features affecting— Drainage	Features affecting— Irrigation	Features affecting— Terraces and diversions	Features affecting— Grassed waterways
319:(con't)							
Barnes	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
391:							
Cavour	Slight	Severe: excess sodium	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly rooting depth	Limitation: erodes easily percs slowly	Limitation: erodes easily excess sodium
Cresbard	Slight	Severe: excess sodium	Severe: slow refill	Limitation: deep to water	Limitation: excess sodium percs slowly	Favorable	Limitation: excess sodium percs slowly
450:							
Colvin	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily wetness
511:							
Divide	Severe: seepage	Severe: seepage piping wetness	Severe: slow refill cutbanks cave	Limitation: cutbanks cave	Limitation: wetness	Limitation: too sandy wetness	Favorable
536:							
Eckman	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Zell	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
539:							
Edgeley	Moderate: seepage depth to rock	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: depth to rock	Limitation: erodes easily depth to rock	Limitation: erodes easily depth to rock
541:							
Edgeley	Moderate: seepage slope depth to rock	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: slope depth to rock	Limitation: erodes easily depth to rock	Limitation: erodes easily depth to rock
569:							
Embden	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: deep to water	Limitation: soil blowing	Limitation: soil blowing	Favorable
579:							
Embden	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Favorable
Egeland	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: too sandy soil blowing	Favorable

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Limitations for— Embankments, dikes, and levees	Limitations for— Aquifer-fed excavated ponds	Features affecting— Drainage	Features affecting— Irrigation	Features affecting— Terraces and diversions	Features affecting— Grassed waterways
595:							
Emrick	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
Cathay	Moderate: seepage	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly	Favorable	Limitation: excess sodium percs slowly
597:							
Emrick	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
Heimdal	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
605:							
Esmond	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Heimdal	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
753:							
Fram	Moderate: seepage	Severe: piping	Moderate: slow refill deep to water	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Wyard	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness
769:							
Gardena	Severe: seepage	Severe: piping	Moderate: slow refill deep to water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
773:							
Gardena	Severe: seepage	Severe: piping	Moderate: slow refill deep to water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Eckman	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
881:							
Hamerly	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Tonka	Moderate: seepage	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
884:							
Hamerly	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Wyard	Moderate: seepage	Severe: piping wetness	Moderate: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness
893:							
Harriet	Moderate: seepage	Severe: excess sodium piping wetness	Severe: slow refill	Limitation: flooding frost action percs slowly	Limitation: percs slowly wetness	Limitation: erodes easily wetness	Limitation: erodes easily excess sodium wetness
988:							
Heimdal	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Emrick	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
998:							
Heimdal	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Esmond	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
1001:							
Heimdal	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Esmond	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
1015:							
Kensal	Severe: seepage	Severe: seepage	Severe: cutbanks cave	Limitation: deep to water	Favorable	Limitation: too sandy	Favorable
1062:							
LaDelle	Slight	Moderate: piping thin layer	Severe: slow refill	Limitation: deep to water	Limitation: flooding	Favorable	Favorable
1108:							
Larson	Moderate: seepage	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Limitations for— Embankments, dikes, and levees	Limitations for— Aquifer-fed excavated ponds	Features affecting— Drainage	Features affecting— Irrigation	Features affecting— Terraces and diversions	Features affecting— Grassed waterways
1108:(con't)							
Cathay	Moderate: seepage	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly	Favorable	Limitation: excess sodium percs slowly
1188:							
Ludden	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: flooding percs slowly ponding	Limitation: percs slowly slow intake ponding	Limitation: percs slowly ponding	Limitation: percs slowly wetness
1189:							
Ludden, saline	Slight	Severe: hard to pack wetness	Severe: slow refill	Limitation: flooding frost action percs slowly	Limitation: percs slowly slow intake wetness	Limitation: percs slowly wetness	Limitation: excess salt percs slowly wetness
1221:							
Maddock	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
Hecla	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: deep to water	Limitation: fast intake soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
1267:							
Marysland	Severe: seepage	Severe: seepage wetness	Severe: slow refill cutbanks cave	Limitation: frost action cutbanks cave	Limitation: wetness	Limitation: too sandy wetness	Limitation: wetness
1268:							
Marysland, wet	Severe: seepage	Severe: seepage ponding	Severe: cutbanks cave	Limitation: frost action ponding cutbanks cave	Limitation: ponding	Limitation: too sandy ponding	Limitation: wetness
1427:							
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
1454:							
Wyndmere	Severe: seepage	Severe: piping	Severe: slow refill cutbanks cave	Limitation: frost action cutbanks cave	Limitation: wetness soil blowing	Limitation: too sandy wetness soil blowing	Favorable
1466:							
Pits, sand and gravel	Severe: seepage slope	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: slope too sandy	Limitation: slope droughty

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Limitations for— Embankments, dikes, and levees	Limitations for— Aquifer-fed excavated ponds	Features affecting— Drainage	Features affecting— Irrigation	Features affecting— Terraces and diversions	Features affecting— Grassed waterways
1710:							
Southam	Slight	Severe: thin layer ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily excess salt wetness
1762:							
Svea	Moderate: seepage	Severe: piping	Severe: slow refill	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
Barnes	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
1765:							
Svea	Moderate: seepage slope	Severe: piping	Severe: slow refill	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Buse	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
1766:							
Svea	Moderate: seepage slope	Severe: piping	Severe: slow refill	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Buse	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
1769:							
Svea	Moderate: seepage	Severe: piping	Severe: slow refill	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
Cresbard	Slight	Severe: excess sodium	Severe: slow refill	Limitation: deep to water	Limitation: excess sodium percs slowly	Favorable	Limitation: excess sodium percs slowly
1781:							
Swenoda	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
1843:							
Towner	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: erodes easily soil blowing	Limitation: erodes easily droughty
1883:							
Vallers	Slight	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for—			Features affecting—			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1843:(con't)							
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
1886:							
Hamerly, saline	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: excess salt frost action	Limitation: excess salt wetness	Limitation: erodes easily wetness	Limitation: erodes easily excess salt
Vallers, saline	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: excess salt frost action	Limitation: excess salt wetness	Limitation: erodes easily wetness	Limitation: erodes easily excess salt wetness
1970:							
Walum	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: deep to water	Limitation: soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
1978:							
Water	—	—	—	—	—	—	—
2118:							
Fram	Moderate: seepage	Severe: piping	Moderate: slow refill deep to water	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Tonka	Moderate: seepage	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
2121:							
Ferney	Slight	Severe: excess sodium piping	Severe: slow refill	Limitation: excess salt percs slowly	Limitation: percs slowly wetness	Limitation: percs slowly wetness	Limitation: excess sodium percs slowly
2151:							
Binford	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
Coe	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: large stones too sandy	Limitation: large stones droughty
2152:							
Coe	Severe: seepage slope	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: large stones slope too sandy	Limitation: large stones slope droughty

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2152: (con't)							
Binford	Severe: seepage slope	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: slope too sandy soil blowing	Limitation: slope droughty
2153:							
Edgeley	Severe: slope	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: slope depth to rock	Limitation: erodes easily slope depth to rock	Limitation: erodes easily slope depth to rock
Kloten	Severe: seepage slope depth to rock	Severe: piping thin layer	Severe: no water	Limitation: deep to water	Limitation: slope thin layer depth to rock	Limitation: area reclaim slope depth to rock	Limitation: area reclaim slope depth to rock
Esmond	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
2156:							
Lamoure	Moderate: seepage	Severe: wetness	Severe: slow refill	Limitation: flooding frost action	Limitation: flooding wetness	Limitation: erodes easily wetness	Limitation: erodes easily wetness
Rauville	Severe: seepage	Severe: hard to pack wetness	Severe: slow refill cutbanks cave	Limitation: flooding frost action	Limitation: flooding wetness	Limitation: wetness	Limitation: wetness
2157:							
Maddock	Severe: seepage slope	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: slope too sandy soil blowing	Limitation: slope droughty
Esmond	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Embden	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Favorable
2158:							
Velva	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Favorable
2159:							
Walsh	Moderate: seepage slope	Severe: hard to pack piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2196:							
Bearden, saline	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: excess salt frost action	Limitation: excess salt wetness	Limitation: erodes easily wetness	Limitation: erodes easily excess salt
Colvin, saline	Moderate: seepage	Severe: wetness	Severe: slow refill	Limitation: frost action percs slowly	Limitation: erodes easily percs slowly wetness	Limitation: erodes easily percs slowly wetness	Limitation: erodes easily excess salt wetness
2197:							
Edgeley	Moderate: seepage slope depth to rock	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: slope depth to rock	Limitation: erodes easily depth to rock	Limitation: erodes easily depth to rock
Kloten	Severe: seepage depth to rock	Severe: piping thin layer	Severe: no water	Limitation: deep to water	Limitation: slope thin layer depth to rock	Limitation: area reclaim depth to rock	Limitation: area reclaim depth to rock
2198:							
Hamar	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Limitation: cutbanks cave	Limitation: fast intake wetness droughty	Limitation: too sandy wetness soil blowing	Limitation: wetness droughty
Hecla	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: deep to water	Limitation: fast intake soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
2199:							
Hamerly	Moderate: seepage	Severe: piping	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Barnes	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily large stones	Limitation: erodes easily large stones
Tonka	Moderate: seepage	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
2200:							
Letcher	Severe: seepage	Severe: excess sodium piping	Severe: no water	Limitation: deep to water	Limitation: percs slowly	Limitation: soil blowing	Limitation: excess sodium percs slowly
Swenoda	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily

Table 18.—Water Management--(continued)

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for—			Features affecting—			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2201:							
Stirum	Severe: seepage	Severe: seepage piping ponding	Severe: slow refill cutbanks cave	Limitation: ponding cutbanks cave	Limitation: ponding droughty	Limitation: too sandy soil blowing ponding	Limitation: excess sodium excess salt wetness
Arveson, saline	Severe: seepage	Severe: seepage piping wetness	Severe: cutbanks cave	Limitation: excess salt frost action cutbanks cave	Limitation: wetness soil blowing droughty	Limitation: too sandy wetness soil blowing	Limitation: excess salt wetness droughty
2202:							
Swenoda	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
Barnes	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
2203:							
Swenoda	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
Barnes	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
2204:							
Walsh	Moderate: seepage slope	Severe: hard to pack piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2205:							
Zell	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Eckman	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by or estimated from the field examination of soils and laboratory testing. During the survey, many shallow borings are made and examined to identify and classify soils and delineate them on soil maps. Samples are taken from some typical soils and tested in the laboratory to determine physical and chemical soil properties. Standard laboratory procedures are followed. Information from the laboratory and results from samples from similar soils in nearby areas are used to verify field observations and properties that cannot be estimated accurately in the field. The laboratory analyses also help to characterize key soils.

Estimates of soil properties shown in the tables include the range of soil texture, Atterberg limits, engineering classifications, and other physical and chemical properties of the major layers of each soil. Pertinent soil and water features are also given.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Pedons were sampled for engineering properties. The analyses were made by the North Dakota State Department of Transportation.

Engineering Index Properties

Table 19, "Engineering Index Properties," gives estimates of the engineering classification and range of index properties for 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 in the series descriptions of this publication, under the heading "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 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 (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups, from A-1 through A-7, on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 10 inches in diameter and 3 to 10 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. Estimates are based on test data from the survey area or from nearby areas and on field examination.

Estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical Properties

Table 20, "Physical Properties of the Soils," 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 test data for these and similar soils.

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 in the series descriptions of this publication, under the heading "Soil Series and Their Morphology."

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. Clay determines the ability of soil to adsorb cations and retain moisture. Clay influences shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In Table 20, "Physical Properties of the Soils," the estimated range in moist bulk density of each major soil layer is expressed in grams per cubic centimeter of soil material less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. Moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, organic matter content, and soil structure.

Ksat (permeability/saturated hydraulic conductivity) 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 and septic tank absorption fields.

Available water capacity refers to the quantity of water the soil is capable of storing for use by plants. The range in 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 retention of water and depth of the root zone. The most important soil properties are organic matter content, 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 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.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain of 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 magnitude of the load on the soil and 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 features are 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 classes are **low**, a change of less than 3 percent; **moderate**, 3 to 6 percent; and **high**, more than 6 percent. **Very high**, more than 9 percent, is sometimes used.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In Table 20, "Physical Properties of the Soils," the estimated range in organic matter content is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects available water capacity, infiltration rates, and tilth. It is a source of nitrogen and other nutrients for crops.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Soil properties that influence erodibility are those that affect the infiltration rate, movement of water though the soil, water storage capacity of the soil, and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt, sand, and organic matter and soil structure and permeability. The factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion factor Kf is similar to the erosion factor K, except it indicates the erodibility of only the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-loss tolerance factor T is an estimate of the maximum annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is expressed in tons per acre per year. Ratings of 1 to 5 are used depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind erodibility groups (WEG) are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

WEG 1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

WEG 2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are highly erodible. Crops can be grown if measures to control wind erosion are used.

WEG 5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

WEG 6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

Wind erodibility index (I) is a numerical value indicating the potential annual soil loss due to wind erosion for a soil under a well defined set of climatic and management conditions. This factor is expressed as the average annual soil loss in tons per acre per year.

Chemical Properties

Table 21, "Chemical Properties of the Soils," shows estimates of some soil chemical properties that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on test data for these and similar soils. These features are described in the following paragraphs.

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 in the series descriptions of this publication, under the heading "Soil Series and Their Morphology."

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material less than 2 millimeters in diameter.

Cation-exchange capacity is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations helps to prevent pollution of groundwater.

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.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the soil. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization. Calcium carbonate also affects susceptibility of a soil to wind erosion.

Gypsum is given as the percent, by weight, of hydrated calcium sulfates in the soil. Gypsum is partially soluble in water and can be dissolved and removed by water. Soils that have a high content of gypsum (more than 10 percent) may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity (EC) 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 the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is the measure of sodium relative to calcium and magnesium in the water extract from a saturated soil paste. Soils having a sodium adsorption ratio of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

Table 22, "Water Features," gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Hydrologic soil groups are groups of soils that have the same runoff potential under similar storm and ground cover conditions. Soil properties that affect the runoff potential are those that influence the rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of very 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 mainly of moderately deep or deep, moderately well or well drained soils that have moderately fine 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 mainly of soils having a layer that impedes the downward movement of water or soils that have a moderately fine 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 mainly of clayey soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups, the first letter is for drained areas and the second is for undrained areas.

Water table (seasonal) refers to a zone in the soil that is at saturation in most years. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Estimates of water table depths are based mainly on the evidence of a saturated zone that exists in a soil, namely a combination of grayish colors or redoximorphic features. Water tables may either be apparent or perched. An apparent water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time is allowed for adjustments in the surrounding soil. A perched water table is water standing above an unsaturated zone in the soil. A perched water table may be separated from a lower water table by an unsaturated zone. Water tables usually are perched by textural discontinuities in the soil profile. A perched water table may be confirmed if the water level in a borehole falls when the borehole is extended.

Indicated in Table 22, "Water Features," are the **upper limit** and **lower limit** in the depth of the water table found in the soil in most years. These depth ranges are given to the nearest tenth of a foot and are listed by month. If no water table exists in the soil, no information is given.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. Ponding of soils is classified according to the depth, duration, frequency, and the beginning and ending months in which water is observed.

Surface water depth is the maximum depth of surface water that is ponded on the soil.

Ponding duration is the average length of time of the ponding occurrence. Ponding duration classes are **very brief** (less than 2 days), **brief** (2 to 7 days), **long** (7 to 30 days), or **very long** (more than 30 days).

Ponding frequency is the number of times ponding occurs over a period of time. Ponding frequency classes are **none** (no reasonable possibility of ponding), **rare** (ponding unlikely but possible under unusual weather conditions; 0 to 5 percent chance of ponding in any year); **occasional** (ponding is expected infrequently under usual weather conditions; 5 to 50 percent chance of ponding in any year); and **frequent** (ponding is likely to occur under usual weather conditions; more than 50 percent chance in any year).

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

Table 22, "Water Features," gives the **duration** and **frequency** of flooding and the time of year when flooding is most likely to occur. Flooding frequency classes are identical to ponding frequency classes. Flooding duration classes are **extremely brief** (0.1 to 4 hours), **very brief** (4 to 48 hours), **brief** (2 to 7 days), **long** (7 to 30 days), and **very long** (more than 30 days). Frequency, duration, and probable dates of occurrence are estimated.

The information on flooding 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 little or no horizon development.

Also considered in making flooding estimates are local information about the extent and level 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.

Soil Features

Table 23, "Soil Features," gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Restrictions are nearly continuous soil layers that significantly reduce the movement of water and air through the soil or that otherwise provide an unfavorable root environment. Restriction kind is the type of restriction. Examples of restrictions include bedrock, cemented layers, and dense layers. Restriction thickness is the distance from the top to the bottom of a restrictive layer. Restriction hardness refers to the rupture resistance or strength of the layer.

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, organic matter content, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed 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 to pavements and other rigid structures.

A **low** potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a **moderate** potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a **high** potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

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 features may be needed if the combination of factors results in a severe hazard of corrosion. 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.

Hydric Soils

Table 24, "Hydric Soils List," shows which map units have components that meet the definition of hydric soils in Griggs County. This table can help in planning land uses; however, onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; USDA-NRCS, 1996.) Map units that are made up of hydric soils may have small areas or inclusions, of nonhydric soils in the higher positions on the landform, and map units made up of nonhydric soils may have inclusions of hydric soils in the lower positions of the landform.

Three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin, et al., 1979; Environmental Laboratory, 1987; National Research Council, 1995; Tiner, 1985). Criteria for each of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria which identify those estimated soil properties unique to hydric soils have been established (Federal Register, 1995.) These criteria are used to identify a phase of a soil series that normally is associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1975; 1996a) and in the "Soil Survey Manual" (Soil Survey Staff, 1993.)

If soils are wet enough for a long enough period to be considered hydric, they should exhibit certain properties that can be easily observed in the field.

These visible properties are indicators of hydric soils. The indicators that can be used to make onsite determinations of hydric soils in Griggs County are specified in "Field Indicators of Hydric Soils in the United States" (USDA-NRCS, 1996).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described as deep as necessary to understand the redoximorphic processes. Then, using the completed soil description, soil scientists can compare soil features required by each hydric soil indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if one (or more) of the approved indicators is present.

This survey can be used to locate probable areas of hydric soils. The hydric soil may have been artificially drained or otherwise altered such that it no longer supports a predominance of hydrophytic vegetation. The soil map does not identify drained areas.

Table 19.—Engineering Index Properties

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
61:												
Arveson	0-9	fine sandy loam	SM	A-2-4, A-4	—	0-1	100	95-100	55-85	30-50	0-30	NP-7
	9-39	fine sandy loam, sandy loam, loam	SC-SM, SM	A-4	0	0	100	95-100	60-85	35-50	0-20	NP-5
	39-60	fine sand, loamy sand, fine sandy loam	SM, SC-SM, SP-SM	A-3, A-2, A-4	0	0	100	95-100	50-85	5-50	0-20	NP-5
118:												
Barnes	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL-ML, CL	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Buse	0-7	loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
120:												
Barnes	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Buse	0-7	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
156:												
Barnes	0-9	loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL-ML, CL	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Svea	0-18	loam	CL, CL-ML	A-4, A-6	—	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	18-28	loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	—	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	28-60	loam, silt loam, clay loam	CL-ML, CL	A-4, A-7, A-6	—	0-5	95-100	85-100	80-100	60-85	25-45	10-25
167:												
Bearden	0-9	silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	9-20	silt loam, silty clay loam	CL	A-4, A-7, A-6	0	0	100	100	90-100	80-95	30-45	10-20
	20-60	silt loam, silty clay	CL, CL-ML	A-6, A-4, A-7	0	0	100	100	90-100	80-95	30-45	10-20
296:												
Brantford	0-8	loam	CL-ML, CL	A-4	0	0	90-100	85-95	80-90	60-80	20-30	4-10
	8-15	loam	CL, CL-ML	A-6, A-4	0	0	90-100	85-95	80-90	60-80	30-35	10-15
	15-60	stratified loamy sand to very gravelly coarse sand	GM, SM, SP-SM, GP-GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5

Table 19.—Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
314:												
Buse	0-7	loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
Barnes	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
319:												
Buse	0-7	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
Barnes	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
391:												
Cavour	0-10	loam	MH, ML	A-6, A-4, A-7	0	0	100	90-100	85-100	60-85	30-55	5-20
	10-20	clay, clay loam, silty clay loam	CH, ML, CL, MH	A-6, A-7	0	0	100	90-100	90-100	55-85	35-65	15-30
	20-60	clay loam, loam	CH, CL	A-6, A-7	—	0-5	95-100	90-100	75-100	50-85	35-65	12-35
Cresbard	0-12	loam	CL, ML	A-4, A-6	0	0	100	100	85-100	60-80	30-40	5-15
	12-25	clay loam, silty clay, clay	CH, CL	A-6, A-7	0	0	95-100	90-100	90-100	65-85	30-60	15-30
	25-32	clay loam, silty clay, clay	CH, CL	A-7	0	0	95-100	90-100	85-100	65-85	40-60	15-30
	32-60	clay loam, loam	CH, CL	A-7, A-6	—	0-5	95-100	90-100	85-100	50-80	25-55	10-27
450:												
Colvin	0-10	silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	80-95	30-35	10-15
	10-30	silt loam, silty clay loam	CL, CL-ML	A-7, A-6, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	30-60	loam, silt loam, silty clay loam	CL-ML, CL	A-4, A-7, A-6	0	0	100	100	90-100	70-95	30-45	10-20
511:												
Divide	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	85-95	60-85	25-35	5-15
	9-28	loam, clay loam, gravelly loam	CL-ML, CL	A-6, A-7	0	0-5	95-100	75-100	55-90	35-80	30-45	10-25
	28-60	stratified sand to gravelly sand	SP-SM, SM, GP-GM	A-1, A-3, A-2	0	0-5	25-100	15-100	10-70	5-25	0-15	NP-5

Table 19.—Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
536:												
Eckman	0-8	silt loam	ML	A-4	0	0	100	100	85-100	70-90	20-40	NP-10
	8-19	silt loam, very fine sandy loam	ML	A-4	0	0	100	100	85-100	55-90	20-40	NP-10
	19-60	silt loam, very fine sandy loam, fine sandy loam	ML, SM	A-4	0	0	100	100	65-100	40-90	20-40	NP-10
Zell	0-8	silt loam	ML, CL-ML, CL	A-4	0	0	100	95-100	85-100	80-100	20-30	5-10
	8-20	silt loam, very fine sandy loam, loam	CL-ML, CL, ML	A-4	0	0	100	95-100	85-100	70-100	20-30	5-10
	20-60	silt loam, very fine sandy loam, loam	CL, CL-ML, ML	A-4	0	0	100	95-100	85-100	60-100	15-30	NP-10
539:												
Edgeley	0-8	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	8-32	clay loam, silty clay loam, silt loam	CL, CH, MH	A-6, A-7	0	0-5	80-100	75-100	65-95	55-95	25-75	10-40
	32-60	weathered bedrock			—	—	—	—	—	—	—	—
541:												
Edgeley	0-8	loam	CL, CL-ML	A-6, A-4	0	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	8-32	clay loam, silty clay loam, silt loam	CH, CL, MH	A-6, A-7	0	0-5	80-100	75-100	65-95	55-95	25-75	10-40
	32-60	weathered bedrock			—	—	—	—	—	—	—	—
569:												
Embden	0-16	fine sandy loam	CL-ML, SC, SC-SM	A-4, A-2	0	0	100	100	60-95	30-75	20-30	4-10
	16-38	fine sandy loam, sandy loam	CL-ML, SC-SM, SC	A-4, A-2	0	0	100	100	60-100	25-55	20-30	5-10
	38-60	fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC, SM	A-4, A-2	0	0	100	100	50-100	15-55	15-30	NP-10
579:												
Embden	0-16	fine sandy loam	SC, CL-ML, SC-SM	A-2, A-4	0	0	100	100	60-95	30-75	20-30	4-10
	16-38	fine sandy loam, sandy loam	SC-SM, SC, CL-ML	A-2, A-4	0	0	100	100	60-100	25-55	20-30	5-10
	38-60	fine sandy loam, sandy loam, loamy fine sand	SC, SM, CL-ML	A-4, A-2	0	0	100	100	50-100	15-55	15-30	NP-10

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(—-) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
579: (con't)												
Egeland	0-9	fine sandy loam	SC-SM, SC	A-2, A-4	0	0	100	95-100	75-100	30-50	20-30	5-10
	9-40	sandy loam, fine sandy loam	SC-SM, SC	A-2, A-4	0	0	95-100	85-100	70-100	15-50	20-30	5-10
	40-60	loamy sand, loamy fine sand, loamy very fine sand	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	10-50	15-20	NP-5
595:												
Emrick	0-13	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	0-40	NP-10
	13-32	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	55-75	0-40	NP-10
	32-60	loam, sandy loam	ML, SC, SM	A-4, A-6	0-1	0-5	90-100	90-100	60-100	35-90	0-40	NP-10
Cathay	0-10	loam	ML, CL, CL-ML	A-4	—	0-5	95-100	90-100	75-95	50-95	25-35	5-10
	10-22	clay loam, loam	CL	A-6	—	0-5	95-100	90-100	85-95	60-85	25-40	10-25
	22-60	loam	ML, CL-ML, CL	A-4, A-6	—	0-5	95-100	90-100	85-95	60-75	25-40	3-25
597:												
Emrick	0-13	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	0-40	NP-10
	13-32	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	55-75	0-40	NP-10
	32-60	loam, sandy loam	ML, SC, SM	A-4, A-6	0-1	0-5	90-100	90-100	60-100	35-90	0-40	NP-10
Heimdal	0-7	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-14	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	14-60	loam, sandy loam, fine sandy loam	ML, CL, SC, SM	A-6, A-4	0-1	0-5	95-100	90-100	60-100	35-90	20-40	NP-15
605:												
Esmond	0-8	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	loam, sandy loam, fine sandy loam	SC, CL, ML, SM	A-4, A-6	—	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
Heimdal	0-7	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-14	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	14-60	loam, sandy loam, fine sandy loam	CL, ML, SC, SM	A-4, A-6	0-1	0-5	95-100	90-100	60-100	35-90	20-40	NP-15
753:												
Fram	0-18	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	18-60	sandy loam, fine sandy loam, loam	ML, SM	A-4	—	0-1	95-100	90-100	60-100	35-90	20-40	NP-10
Wyard	0-15	loam	CL-ML, CL	A-7, A-6, A-4	0	0	95-100	90-100	85-100	60-90	25-45	5-25
	15-21	loam, silt loam	SC, CL, CL-ML	A-4, A-6, A-7	0	0	95-100	90-100	80-100	35-85	25-45	5-25
	21-35	loam, silt loam, clay loam	SC, CL-ML, CL	A-4, A-7, A-6	0	0-10	95-100	90-100	80-100	35-85	25-45	5-25
	35-60	loam, sandy loam, clay loam	CL-ML, ML, SC, CL	A-6, A-4, A-7	0	0-10	95-100	90-100	80-100	35-85	20-45	3-20

Table 19.—Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
769:												
Gardena	0-18	silt loam	CL, ML	A-4, A-6	0	0	100	100	90-100	70-100	25-40	NP-15
	18-60	silt loam, very fine sandy loam, loam	CL, CL-ML, ML	A-4, A-6	0	0	100	100	75-100	55-100	20-40	NP-15
773:												
Gardena	0-18	silt loam	CL, ML	A-4, A-6	0	0	100	100	90-100	70-100	25-40	NP-15
	18-60	silt loam, very fine sandy loam, loam	CL-ML, CL, ML	A-4, A-6	0	0	100	100	75-100	55-100	20-40	NP-15
Eckman	0-8	silt loam	ML	A-4	0	0	100	100	85-100	70-90	20-40	NP-10
	8-19	silt loam, very fine sandy loam	ML	A-4	0	0	100	100	85-100	55-90	20-40	NP-10
	19-60	silt loam, very fine sandy loam, fine sandy loam	ML, SM	A-4	0	0	100	100	65-100	40-90	20-40	NP-10
881:												
Hamerly	0-10	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	10-29	loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	29-60	loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Tonka	0-17	silt loam	CL, CL-ML	A-6, A-4	0-1	0-2	100	95-100	90-100	70-90	35-45	15-25
	17-40	silty clay loam, clay loam, clay	CH, CL	A-7, A-6	0-1	0-2	100	95-100	90-100	75-95	50-60	30-40
	40-60	silty clay loam, clay loam, loam	CL, CL-ML	A-7, A-6, A-4	0-1	0-3	90-100	85-100	60-100	50-90	35-55	15-30
884:												
Hamerly	0-10	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	10-29	loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	29-60	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Wyard	0-15	loam	CL-ML, CL	A-6, A-7, A-4	0	0	95-100	90-100	85-100	60-90	25-45	5-25
	15-21	loam, silt loam	CL, SC, CL-ML	A-7, A-4, A-6	0	0	95-100	90-100	80-100	35-85	25-45	5-25
	21-35	loam, silt loam, clay loam	CL, SC, CL-ML	A-4, A-6, A-7	0	0-10	95-100	90-100	80-100	35-85	25-45	5-25
	35-60	loam, sandy loam, clay loam	CL-ML, ML, CL, SC	A-4, A-7, A-6	0	0-10	95-100	90-100	80-100	35-85	20-45	3-20
893:												
Harriet	0-2	silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	25-40	5-20
	2-10	clay loam, silty clay loam, silty clay	CH, CL	A-6, A-7	0	0	100	100	90-100	70-100	35-70	20-40
	10-60	loam, silty clay loam, clay loam	CH, CL	A-6	0	0	100	100	90-100	60-100	25-55	10-30

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(—) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
988:												
Heimdal	0-7	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-14	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	14-60	loam, sandy loam, fine sandy loam	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	90-100	60-100	35-90	20-40	NP-15
Emrick	0-13	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	0-40	NP-10
	13-32	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	55-75	0-40	NP-10
	32-60	loam, sandy loam	SM, SC, ML	A-4, A-6	0-1	0-5	90-100	90-100	60-100	35-90	0-40	NP-10
998:												
Heimdal	0-7	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-14	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	14-60	loam, sandy loam, fine sandy loam	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	90-100	60-100	35-90	20-40	NP-15
Esmond	0-8	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	loam, sandy loam, fine sandy loam	ML, CL, SC, SM	A-6, A-4	—	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
1001:												
Heimdal	0-7	loam	ML	A-4	0-1	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	7-14	loam	ML	A-4	0-1	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	14-60	loam, sandy loam, fine sandy loam	SC, SM, ML, CL	A-6, A-4	0-1	0-5	95-100	90-100	60-100	35-90	20-40	NP-15
Esmond	0-8	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	loam, sandy loam, fine sandy loam	SC, SM, ML, CL	A-4, A-6	—	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
1015:												
Kensal	0-9	loam	CL-ML, ML, CL	A-4, A-6	0	0	95-100	95-100	85-95	60-75	15-35	3-15
	9-23	loam, sandy loam	SM, CL, SC, ML	A-2, A-4, A-6	0	0	95-100	95-100	60-95	30-75	15-35	3-15
	23-60	loamy sand,	GM, SP-SM, GP-GM, SM	A-1, A-2	—	5-25	50-95	30-75	15-60	10-30	0-14	NP
1062:												
LaDelle	0-23	silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	23-43	silty clay loam	CL, ML	A-6, A-7	0	0	100	100	95-100	85-100	35-50	10-25
	43-60	silty clay loam, silt loam, loam	CL, ML	A-4, A-7, A-6	0	0	100	100	90-100	75-100	30-50	5-25
1108:												
Larson	0-8	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-100	75-100	50-90	15-40	5-20
	8-21	loam, clay loam, silty clay loam	CL	A-6, A-7	0	0-5	95-100	85-100	75-100	60-80	30-45	10-25
	21-60	loam, clay loam, silt loam	CL, CL-ML	A-7, A-6, A-4	0	0-5	95-100	85-100	75-100	50-90	15-45	5-25

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
1108:(con't)												
Cathay	0-10	loam	CL, CL-ML, ML	A-4	--	0-5	95-100	90-100	75-95	50-95	25-35	5-10
	10-22	clay loam, loam	CL	A-6	--	0-5	95-100	90-100	85-95	60-85	25-40	10-25
	22-60	loam	CL, CL-ML, ML	A-4, A-6	--	0-5	95-100	90-100	85-95	60-75	25-40	3-25
1188:												
Ludden	0-35	silty clay	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
	35-42	silty clay, clay	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
	42-60	silty clay, clay, clay loam	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
1189:												
Ludden, saline	0-35	silty clay	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
	35-42	silty clay, clay	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
	42-60	silty clay, clay, clay loam	CH	A-7	0	0	100	100	95-100	75-95	50-75	25-50
1221:												
Maddock	0-11	loamy fine sand	SM, SC-SM	A-2, A-4	0	0	100	95-100	50-80	15-35	15-20	NP-5
	11-60	loamy sand, loamy fine sand, fine sand	SC-SM, SM, SP-SM	A-2, A-3	0	0	100	95-100	60-100	5-35	15-20	NP-3
Hecla	0-10	loamy fine sand	SC-SM, SP-SM, SM	A-2	0	0	100	95-100	85-100	12-35	10-20	NP-5
	10-32	loamy sand, loamy fine sand, fine sand	SP-SM, SM, SC-SM	A-2, A-3	0	0	100	95-100	85-100	5-35	10-20	NP-5
	32-60	loamy sand, fine sand, loamy fine sand	SP-SM, SC-SM, SM	A-3, A-2	0	0	100	95-100	85-100	5-35	10-20	NP-5
1267:												
Marysland	0-8	loam	CL	A-4, A-7, A-6	0	0-5	95-100	95-100	85-95	50-80	25-50	10-25
	8-30	loam, clay loam, sandy clay loam	SC, CL	A-6, A-7	0	0-5	90-100	85-100	80-95	45-80	20-45	10-20
	30-60	stratified fine sand to gravelly coarse sand	SP-SM, SM, GP-GM	A-1, A-2, A-3	0	0-5	70-95	50-90	35-70	5-20	0-15	NP-5
1268:												
Marysland, wet	0-8	loam	CL	A-7, A-6	0	0	95-100	95-100	85-95	50-80	30-50	10-25
	8-30	loam, clay loam, sandy clay loam	CL, SC	A-6	0	0	90-100	85-100	80-95	45-80	20-40	10-20
	30-60	stratified fine sand to gravelly coarse sand	SM, SP-SM	A-2, A-1, A-3	0	0	70-95	50-90	35-70	5-20	0-14	NP

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1427:												
Parnell	0-9	silty clay loam	CH, CL, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	9-49	clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	49-60	clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
1454:												
Wyndmere	0-9	fine sandy loam	ML, SC-SM, SC, SM	A-2, A-4	0	0	100	100	60-80	30-55	10-30	NP-10
	9-28	sandy loam, fine sandy loam	SC, SC-SM, ML, SM	A-2, A-4	0	0	100	100	60-90	30-55	10-30	NP-10
	28-42	fine sand, loamy fine sand, fine sandy loam	ML, SM	A-2, A-4	0	0	100	100	60-100	20-55	0-14	NP
	42-60	loam, clay loam	CL, CL-ML	A-4, A-7, A-6	--	0-5	90-100	85-100	75-100	55-90	20-45	5-30
1466:												
Pits, sand and gravel	0-6	extremely gravelly sand	GW-GM, SW-SM	A-1, A-3	0	0-5	25-90	10-65	5-35	0-25	0-15	NP-5
	6-60	extremely gravelly sand, extremely gravelly coarse sand, gravelly coarse sandy loam	GW-GM, SW-SM	A-1, A-3	0	0-10	25-90	10-65	5-35	0-25	0-15	NP-5
1710:												
Southam	0-10	silty clay loam	CH, CL, OL	A-7	0	0	100	95-100	90-100	80-100	40-55	20-35
	10-48	silty clay, clay, silty clay loam	CH, CL	A-7	0	0	100	95-100	90-100	85-100	50-65	30-40
	48-60	silty clay, silty clay loam, loam	CH, CL, CL-ML	A-6, A-7	0	0-1	100	95-100	85-100	60-100	35-65	15-40
1762:												
Svea	0-18	loam	CL, CL-ML	A-4, A-6	--	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	18-28	loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	--	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	28-60	loam, silt loam, clay loam	CL, CL-ML	A-7, A-4, A-6	--	0-5	95-100	85-100	80-100	60-85	25-45	10-25
Barnes	0-9	loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	9-14	loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	14-60	loam, clay loam	CL-ML, CL	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1765:												
Svea	0-18	loam	CL-ML, CL	A-4, A-6	—	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	18-28	loam, silt loam, clay loam	CL, CL-ML	A-7, A-6, A-4	—	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	28-60	loam, silt loam, clay loam	CL, CL-ML	A-6, A-7, A-4	—	0-5	95-100	85-100	80-100	60-85	25-45	10-25
Buse	0-7	loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
1766:												
Svea	0-18	loam	CL, CL-ML	A-4, A-6	—	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	18-28	loam, silt loam, clay loam	CL, CL-ML	A-4, A-7. A-6	—	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	28-60	loam, silt loam, clay loam	CL-ML, CL	A-6, A-4, A-7	—	0-5	95-100	85-100	80-100	60-85	25-45	10-25
Buse	0-7	loam	CL-ML, CL	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	7-60	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
1769:												
Svea	0-18	loam	CL, CL-ML	A-4, A-6	—	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	18-28	loam, silt loam, clay loam	CL-ML, CH	A-4, A-6, A-7	—	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	28-60	loam, silt loam, clay loam	CL-ML, CL	A-6, A-7, A-4	—	0-5	95-100	85-100	80-100	60-85	25-45	10-25
Cresbard	0-12	loam	CL, ML	A-4, A-6	0	0	100	100	85-100	60-80	30-40	5-15
	12-25	clay loam, silty clay, clay	CH, CL	A-6, A-7	0	0	95-100	90-100	90-100	65-85	30-60	15-30
	25-32	clay loam, silty clay, clay	CH, CL	A-7	0	0	95-100	90-100	85-100	65-85	40-60	15-30
	32-60	clay loam, loam	CH, CL	A-6, A-7	—	0-5	95-100	90-100	85-100	50-80	25-55	10-27
1781:												
Swenoda	0-13	fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	13-33	fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	33-60	silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1843:												
Towner	0-16	loamy fine sand	SC-SM, SM	A-2	0	0	100	100	50-80	15-35	15-25	NP-5
	16-35	loamy sand, loamy fine sand, fine sand	SW-SM, SC-SM, SM	A-3, A-2	0	0	100	95-100	50-100	5-35	15-25	NP-5
	35-60	loam, silt loam, silty clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-5	95-100	90-100	85-100	55-100	25-50	5-30
1883:												
Vallers	0-12	loam	CL-ML, ML	A-4	0-1	0-5	95-100	90-100	80-90	50-80	30-40	4-10
	12-32	clay loam, silty clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	50-80	30-40	11-20
	32-60	loam, clay loam	CL, CL-ML	A-6, A-4	0-1	0-5	95-100	90-100	85-95	60-85	20-40	5-20
Parnell	0-9	silty clay loam	OL, CH, CL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	9-49	clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	49-60	clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
1886:												
Hamerly, saline	0-10	loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	25-40	10-20
	10-29	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	25-45	10-25
	29-60	loam, clay loam	CL-ML, CL	A-4, A-7, A-6	0	0-5	95-100	90-100	80-95	60-75	25-45	10-25
Vallers, saline	0-12	loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	80-90	65-80	25-40	10-20
	12-32	clay loam, silty clay loam, loam	CL	A-6, A-4, A-7	0-1	0-5	95-100	90-100	80-95	50-80	25-45	10-25
	32-60	loam, clay loam	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-75	25-45	10-25
1970:												
Walum	0-16	sandy loam	ML, CL, SC, SM	A-2, A-4	0	0	95-100	90-100	60-85	30-55	15-30	NP-10
	16-30	sandy loam, sand, gravelly loamy sand	ML, CL-ML, SC-SM, SM	A-2, A-4	0	0	95-100	75-100	50-85	15-55	15-30	NP-7
	30-60	sand and gravel	SM, SP-SM	A-1, A-3, A-2	0	0	70-90	40-85	25-55	5-15	0-20	NP
1978:												
Water	---	---	---	---	---	---	---	---	---	---	---	---
2118:												
Fram	0-18	loam	ML	A-4	---	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	18-60	sandy loam, fine sandy loam, loam	ML, SM	A-4	---	0-1	95-100	90-100	60-100	35-90	20-40	NP-10

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2118:(con't)												
Tonka	0-17	silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	35-45	15-25
	17-40	silty clay loam, clay loam, clay	CL, CH	A-6, A-7	0-1	0-2	100	95-100	90-100	75-95	50-60	30-40
	40-60	silty clay loam, clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-1	0-3	90-100	85-100	60-100	50-90	35-55	15-30
2121:												
Ferney	0-5	loam	CL, CL-ML, ML	A-4, A-6	0	0	100	100	85-95	60-85	30-45	6-20
	5-13	clay, clay loam	CL	A-6, A-7	0	0-5	95-100	95-100	85-95	50-80	30-55	10-35
	13-60	clay, clay loam	CL, ML, SM	A-4, A-7, A-6	0	0-5	95-100	95-100	60-95	30-80	35-65	12-35
2151:												
Binford	0-8	sandy loam	SC, SC-SM, SM	A-4, A-2	0	0	95-100	95-100	60-95	30-50	15-30	NP-10
	8-17	sandy loam, coarse sandy loam, loam	ML, CL, SC-SM, SM	A-2, A-4	0	0	95-100	95-100	60-85	30-60	15-30	NP-10
	17-60	stratified coarse sand to gravelly coarse sand	GM, SP-SM, GP-GM, SM	A-1, A-2	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
Coe	0-8	sandy loam	CL-ML, SC-SM, SC, SM	A-2, A-4	0	0-5	95-100	95-100	60-80	30-55	15-30	NP-10
	8-60	gravelly coarse sand, gravelly loamy coarse sand, very gravelly sand	SM, GM, SP-SM, GP-GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-3
2152:												
Coe	0-8	gravelly sandy loam	GC-GM, SC-SM, GM, SM	A-2, A-4	0	0-10	50-80	40-70	30-60	25-50	15-30	NP-10
	8-60	gravelly coarse sand, gravelly loamy coarse sand, very gravelly sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-3
Binford	0-8	sandy loam	SM, SC, SC-SM	A-4, A-2	0	0	95-100	95-100	60-95	30-50	15-30	NP-10
	8-17	sandy loam, coarse sandy loam, loam	CL, SC-SM, SM, ML	A-2, A-4	0	0	95-100	95-100	60-85	30-60	15-30	NP-10
	17-60	stratified coarse sand to gravelly coarse sand	SM, SP-SM, GP-GM, GM	A-2, A-1	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
2153:												
Edgeley	0-8	silt loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	8-26	clay loam, silty clay loam, silt loam	CH, CL, MH	A-6, A-7	0	0-5	80-100	75-100	65-95	55-95	25-75	10-40
	26-60	weathered bedrock			--	--	--	--	--	--	--	--

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2153:(con't)												
Kloten	0-9	silt loam	CL, CL-ML	A-4, A-6	0-2	0-10	90-100	90-100	85-95	60-90	20-40	5-20
	9-60	weathered bedrock			—	—	—	—	—	—	—	—
Esmond	0-8	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	loam, sandy loam, fine sandy loam	ML, SC, SM, CL	A-4, A-6	—	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
2156:												
Lamoure	0-9	silt loam	CL, ML	A-7, A-6	0	0	100	100	95-100	85-100	35-50	10-25
	9-30	silty clay loam, silt loam	CL, MH, ML, CH	A-7	0	0	100	100	90-100	60-100	40-70	15-35
	30-60	silty clay loam, silt loam, loam	CL, ML	A-6, A-7	0	0	95-100	95-100	90-100	60-100	30-70	10-35
Rauville	0-28	silt loam	CL, ML	A-6, A-7	0	0	100	100	90-100	80-100	35-50	10-25
	28-60	silty clay loam, silt loam, silty clay	CL, MH, CH, ML	A-6, A-7	0	0	100	100	90-100	85-100	35-60	15-28
2157:												
Maddock	0-11	loamy fine sand	SC-SM, SM	A-2, A-4	0	0	100	95-100	50-80	15-35	15-20	NP-5
	11-60	loamy sand, loamy fine sand, fine sand	SC-SM, SM, SP-SM	A-3, A-2	0	0	100	95-100	60-100	5-35	15-20	NP-3
Esmond	0-8	loam	ML	A-4	—	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-60	loam, sandy loam, fine sandy loam	SC, ML, SM, CL	A-4, A-6	—	0-5	90-100	85-100	60-100	35-90	20-40	NP-15
Embden	0-16	fine sandy loam	ML, SM	A-2, A-4	0	0	100	100	60-95	30-75	0-35	NP-10
	16-38	fine sandy loam, sandy loam	ML, SM	A-2, A-4	0	0	100	100	60-100	25-55	0-14	NP
	38-60	fine sandy loam, sandy loam, loamy fine sand	SM	A-2, A-4	0	0	100	100	50-100	15-50	0-14	NP
2158:												
Velva	0-15	fine sandy loam	CL-ML, SM, ML, SC-SM	A-4	0	0	100	100	60-95	35-65	15-25	NP-5
	15-60	fine sandy loam, very fine sandy loam, loam	ML, SM	A-4	0	0	100	100	70-95	40-75	20-30	NP-5

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2159:												
Walsh	0-8	silty clay loam	CL	A-6, A-7	0	0	95-100	85-100	80-100	70-90	30-50	10-30
	8-60	loam, silt loam, silty clay loam	CL, CL-ML, MH	A-4, A-7, A-6	0	0	95-100	85-100	80-100	60-95	25-60	5-30
2196:												
Bearden, saline	0-9	silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	9-20	silt loam, silty clay loam	CL-ML, CL	A-4, A-6, A-7	0	0	100	100	95-100	80-95	30-45	10-20
	20-60	silt loam, silty clay loam, loam	CL-ML, CL	A-4, A-7, A-6	0	0	100	100	95-100	80-95	30-45	10-20
Colvin, saline	0-10	silt loam	CL	A-6	0	0	100	100	90-100	80-95	20-35	10-20
	10-60	silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	20-50	10-30
2197:												
Edgeley	0-8	loam	CL-ML, CL	A-6, A-4	0	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	8-32	clay loam, silty clay loam, silt loam	CH, CL, MH	A-6, A-7	0	0-5	80-100	75-100	65-95	55-95	25-75	10-40
	32-60	weathered bedrock			---	---	---	---	---	---	---	---
Kloten	0-9	silt loam	CL, CL-ML	A-4, A-6	0-2	0-10	90-100	90-100	85-95	60-90	20-40	5-20
	9-60	weathered bedrock			---	---	---	---	---	---	---	---
2198:												
Hamar	0-17	loamy fine sand	SM, SC-SM	A-4, A-2	0	0	100	100	85-100	15-40	0-25	NP-5
	17-25	loamy fine sand, loamy sand, fine sand	SC-SM, SM, SP-SM	A-4, A-2	0	0	100	100	70-100	10-40	0-25	NP-5
	25-60	fine sand, loamy sand, loamy fine sand	SM, SC-SM, SP-SM	A-2	0	0	100	100	70-100	10-35	0-25	NP-5
Hecla	0-10	loamy fine sand	SC-SM, SP-SM, SM	A-2	0	0	100	95-100	85-100	12-35	10-20	NP-5
	10-32	loamy sand, loamy fine sand, fine sand	SC-SM, SP-SM, SM	A-3, A-2	0	0	100	95-100	85-100	5-35	10-20	NP-5
	32-60	loamy sand, fine sand, loamy fine sand	SC-SM, SM, SP-SM	A-2, A-3	0	0	100	95-100	85-100	5-35	10-20	NP-5

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2199:												
Hamerly	0-10	stony loam	CL, CL-ML	A-4, A-6	--	3-25	95-100	90-100	80-95	60-90	20-40	5-20
	10-29	loam, clay loam	CL, CL-ML	A-4, A-6, A-7	--	0-10	95-100	90-100	80-95	60-75	20-45	5-25
	29-60	loam, clay loam	CL-ML, CL	A-4, A-6, A-7	--	0-10	95-100	90-100	80-95	60-75	20-45	5-25
Barnes	0-9	very stony loam	CL	A-6	0-5	3-25	90-100	85-100	80-100	60-75	25-40	10-20
	9-14	loam, clay loam, stony loam	CL, CL-ML	A-4, A-6	0-5	0-20	90-100	85-100	75-95	60-80	25-40	5-20
	14-60	loam, clay loam, stony loam	CL, CL-ML	A-6, A-4	0-5	0-15	90-100	85-100	75-95	60-80	25-40	5-20
Tonka	0-17	very stony silt loam	CL-ML, CL	A-4, A-6	5-15	5-20	100	95-100	90-100	70-90	35-45	15-25
	17-40	silty clay loam, clay loam, clay	CH, CL	A-7, A-6	0-3	0-5	100	95-100	90-100	75-95	50-60	30-40
	40-60	silty clay loam, clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-3	0-5	90-100	85-100	60-100	50-90	35-55	15-30
2200:												
Letcher	0-8	fine sandy loam	SC-SM, SM	A-4	0	0	100	100	60-95	35-50	15-30	NP-7
	8-9	sandy loam, fine sandy loam, loamy fine sand	SC-SM, SM	A-2, A-4	0	0	100	100	60-95	20-45	15-30	NP-7
	9-28	loam, sandy loam, fine sandy loam	CL, SC, ML, SM	A-6, A-2, A-4	0	0	100	100	60-95	30-60	25-40	3-18
	28-60	sandy loam, fine sandy loam, loam	CL, ML, SC, SM	A-6, A-2, A-4	0	0	100	95-100	50-95	30-60	25-40	3-18
Swenoda	0-13	fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	13-33	fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	33-60	silt loam, silty clay loam, loam	CL, CL-ML	A-7, A-6	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20
2201:												
Stirum	0-8	fine sandy loam	CL-ML, SM, ML, SC-SM	A-2, A-4	0	0	100	100	60-95	30-60	15-25	NP-5
	8-23	loam, fine sandy loam, sandy loam	CL, SC, SM, ML	A-2, A-4	0	0	100	100	60-95	30-75	15-30	NP-10
	23-60	stratified silty clay loam to loamy sand	CL, SC, SM, ML	A-4, A-2, A-6	0	0	100	100	50-100	15-90	0-30	NP-15

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2201:(con't)												
Arveson, saline	0-9	fine sandy loam	SM	A-2-4, A-4	--	0-1	100	95-100	55-85	30-50	0-30	NP-7
	9-39	fine sandy loam, sandy loam, loam	SC-SM, SM	A-4	0	0	100	95-100	60-85	35-50	0-20	NP-5
	39-60	fine sand, loamy sand, fine sandy loam	SM, SC-SM, SP-SM	A-3, A-2, A-4	0	0	100	95-100	50-85	5-50	0-20	NP-5
2202:												
Swenoda	0-13	fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	13-33	fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	33-60	silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20
Barnes	0-9	fine sandy loam	SM, SC, SC-SM, ML	A-4, A-2, A-6	--	0-5	90-100	85-100	60-95	30-65	20-40	NP-15
	9-14	loam, clay loam	CL, CL-ML	A-4, A-6	--	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	--	0-5	90-100	85-100	75-95	55-80	25-40	5-20
2203:												
Swenoda	0-13	fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	13-33	fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	33-60	silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20
Barnes	0-9	fine sandy loam	SM, SC, SC-SM, ML	A-4, A-2, A-6	--	0-5	90-100	85-100	60-95	30-65	20-40	NP-15
	9-14	loam, clay loam	CL, CL-ML	A-4, A-6	--	0-5	90-100	85-100	75-95	55-80	25-40	5-20
	14-60	loam, clay loam	CL, CL-ML	A-4, A-6	--	0-5	90-100	85-100	75-95	55-80	25-40	5-20
2204:												
Walsh	0-8	silty clay loam	CL	A-6, A-7	0	0	95-100	85-100	80-100	70-90	30-50	10-30
	8-60	loam, silt loam, silty clay loam	CL, CL-ML, MH	A-4, A-6, A-7	0	0	95-100	85-100	80-100	60-95	25-60	5-30

Table 19. Engineering Index Properties--(continued)

(The symbol < means less than; > means more than. Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage Passing sieve number—				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2205:												
Zell	0-8	silt loam	CL, CL-ML, ML	A-4	0	0	100	95-100	85-100	80-100	20-30	5-10
	8-20	silt loam, very fine sandy loam, loam	CL, CL-ML, ML	A-4	0	0	100	95-100	85-100	70-100	20-30	5-10
	20-60	silt loam, very fine sandy loam, loam	CL-ML, ML, CL	A-4	0	0	100	95-100	85-100	60-100	15-30	NP-10
Eckman	0-8	silt loam loam, loam, silt loam	ML	A-4	0	0	100	100	85-100	70-90	20-40	NP-10
	8-19	silt loam, very fine sandy loam	ML	A-4	0	0	100	100	85-100	55-90	20-40	NP-10
	19-60	silt loam, very fine sandy loam, fine sandy loam	SM, ML	A-4	0	0	100	100	65-100	40-90	20-40	NP-10

Table 20.—Physical Properties of the Soils

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(--) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
61:												
Arveson	0-9	10-20	1.25-1.40	2.0-6.0	0.13-0.15	Low	5.0-8.0	.17	.17	4	3	86
	9-39	10-27	1.40-1.55	0.6-6.0	0.15-0.17	Low	1.0-5.0	.24	.24			
	39-60	5-20	1.50-1.65	2.0->20	0.05-0.15	Low	0.0-1.0	.17	.17			
118:												
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
120:												
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
156:												
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
Svea	0-18	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.32	5	6	48
	18-28	18-35	1.30-1.50	0.2-2.0	0.15-0.22	Moderate	2.0-5.0	.28	.32			
	28-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-2.0	.37	.43			
167:												
Bearden	0-9	18-26	1.15-1.30	0.6-2.0	0.20-0.24	Moderate	3.0-7.0	.28	.28	5	4L	86
	9-20	18-34	1.30-1.35	0.2-2.0	0.16-0.22	Moderate	0.0-3.0	.43	.43			
	20-60	18-34	1.30-1.50	0.2-2.0	0.13-0.22	Moderate	0.0-1.0	.43	.43			
296:												
Brantford	0-8	10-19	1.10-1.30	0.6-2.0	0.20-0.22	Low	3.0-6.0	.28	.32	3	5	56
	8-15	18-27	1.25-1.40	0.6-2.0	0.17-0.19	Low	1.0-3.0	.28	.32			
	15-60	2-8	1.35-1.65	6.0->20	0.02-0.04	Low	0.0-0.5	.10	.43			
314:												
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
319:												
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
								K	Kf	T		
	In	Pct	g/cc	in/hour	In/in		Pct					
391:												
Cavour	0-10	18-25	1.10-1.25	0.6-2.0	0.18-0.22	Moderate	2.0-5.0	.37	.37	2	6	48
	10-20	35-50	1.25-1.40	<0.06-0.2	0.10-0.16	High	1.5-2.0	.37	.37			
	20-60	25-35	1.50-1.75	<0.06-0.6	0.11-0.15	Moderate	0.0-0.5	.37	.37			
Cresbard	0-12	20-26	1.15-1.30	0.6-2.0	0.17-0.20	Low	2.0-5.0	.32	.32	5	6	48
	12-25	35-50	1.20-1.35	<0.06-0.6	0.11-0.14	High	0.5-2.0	.32	.32			
	25-32	35-50	1.20-1.35	<0.06-0.6	0.11-0.15	High	0.0-0.5	.32	.32			
	32-60	25-35	1.40-1.60	0.2-0.6	0.16-0.20	Moderate	0.0-0.5	.32	.32			
450:												
Colvin	0-10	18-26	1.15-1.30	0.6-2.0	0.22-0.24	Low	4.0-7.0	.28	.28	5	4L	86
	10-30	18-34	1.20-1.50	0.2-2.0	0.16-0.22	Moderate	1.0-4.0	.43	.43			
	30-60	18-34	1.30-1.50	0.2-2.0	0.16-0.22	Moderate	0.5-1.0	.43	.43			
511:												
Divide	0-9	15-27	1.10-1.40	0.6-2.0	0.20-0.24	Low	2.0-7.0	.24	.24	4	4L	86
	9-28	18-35	1.20-1.50	0.2-2.0	0.15-0.19	Moderate	1.0-3.0	.20	.32			
	28-60	1-10	1.45-1.65	6.0->20	0.02-0.07	Low	0.0-1.0	.10	.15			
536:												
Eckman	0-8	12-18	1.10-1.25	0.6-2.0	0.20-0.24	Low	2.0-6.0	.28	.28	5	5	56
	8-19	10-18	1.20-1.60	0.6-2.0	0.17-0.22	Low	0.0-3.0	.43	.43			
	19-60	10-18	1.20-1.70	0.6-2.0	0.14-0.22	Low	0.0-0.5	.43	.43			
Zell	0-8	10-18	1.15-1.30	0.6-2.0	0.20-0.24	Low	2.0-4.0	.32	.32	5	4L	86
	8-20	10-18	1.30-1.35	0.6-2.0	0.16-0.22	Low	0.5-2.0	.43	.43			
	20-60	5-18	1.30-1.50	0.6-2.0	0.15-0.22	Low	0.0-0.5	.43	.43			
539:												
Edgeley	0-8	18-26	1.30-1.40	0.6-2.0	0.20-0.22	Low	3.0-7.0	.32	.32	3	6	48
	8-32	18-34	1.30-1.50	0.6-2.0	0.13-0.19	Moderate	0.0-2.0	.37	.37			
	32-60	—	—	<0.06-0.2	—	—	0.0-0.0	—	—			
541:												
Edgeley	0-8	18-26	1.30-1.40	0.6-2.0	0.20-0.22	Low	3.0-7.0	.32	.32	3	6	48
	8-32	18-34	1.30-1.50	0.6-2.0	0.13-0.19	Moderate	0.0-2.0	.37	.37			
	32-60	—	—	<0.06-0.2	—	—	0.0-0.5	—	—			
569:												
Embden	0-16	10-18	1.25-1.35	2.0-6.0	0.13-0.18	Low	4.0-7.0	.20	.20	5	3	86
	16-38	10-18	1.30-1.60	2.0-6.0	0.12-0.17	Low	1.0-4.0	.24	.24			
	38-60	5-18	1.40-1.60	2.0-6.0	0.08-0.16	Low	0.0-1.0	.24	.24			
579:												
Embden	0-16	10-18	1.25-1.35	2.0-6.0	0.13-0.18	Low	4.0-7.0	.20	.20	5	3	86
	16-38	10-18	1.30-1.60	2.0-6.0	0.12-0.17	Low	1.0-4.0	.24	.24			
	38-60	5-18	1.40-1.60	2.0-6.0	0.08-0.16	Low	0.0-1.0	.24	.24			
Egeland	0-9	10-18	1.25-1.35	2.0-6.0	0.13-0.18	Low	2.0-4.0	.20	.20	5	3	86
	9-40	10-18	1.30-1.45	2.0-6.0	0.12-0.17	Low	0.0-2.0	.24	.24			
	40-60	5-10	1.40-1.65	2.0-6.0	0.08-0.12	Low	0.0-0.5	.17	.17			
595:												
Emrick	0-13	10-18	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-8.0	.28	.28	5	5	56
	13-32	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	32-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(-—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
595:(con't)												
Cathay	0-10	10-27	1.10-1.40	0.6-2.0	0.20-0.23	Low	2.0-5.0	.32	.32	5	5	56
	10-22	18-35	1.40-1.60	<0.06-0.6	0.16-0.19	Moderate	0.5-2.0	.32	.32			
	22-60	7-18	1.40-1.60	0.2-2.0	0.17-0.19	Moderate	0.0-0.5	.32	.32			
597:												
Emrick	0-13	10-18	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-8.0	.28	.28	5	5	56
	13-32	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	32-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
Heimdal	0-7	10-20	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-5.0	.28	.28	5	5	56
	7-14	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	14-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
605:												
Esmond	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	Low	1.0-3.0	.28	.28	5	4L	86
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	Low	0.0-1.0	.37	.43			
Heimdal	0-7	10-20	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-5.0	.28	.28	5	5	56
	7-14	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	14-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
753:												
Fram	0-18	10-18	1.30-1.60	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.28	5	4L	86
	18-60	7-18	1.40-1.60	0.6-2.0	0.13-0.20	Low	0.0-4.0	.37	.37			
Wyard	0-15	18-27	1.00-1.30	0.6-2.0	0.20-0.24	Moderate	4.0-8.0	.28	.28	5	6	48
	15-21	18-27	1.20-1.30	0.6-2.0	0.20-0.22	Moderate	3.0-5.0	.32	.43			
	21-35	18-35	1.20-1.40	0.6-2.0	0.18-0.22	Moderate	1.0-3.0	.32	.43			
	35-60	15-35	1.30-1.60	0.6-2.0	0.14-0.22	Moderate	0.0-0.5	.37	.43			
769:												
Gardena	0-18	12-18	1.10-1.40	0.6-2.0	0.20-0.24	Low	4.0-8.0	.28	.28	5	5	56
	18-60	10-18	1.20-1.70	0.6-2.0	0.17-0.22	Low	0.0-3.0	.43	.43			
773:												
Gardena	0-18	12-18	1.10-1.40	0.6-2.0	0.20-0.24	Low	4.0-8.0	.28	.28	5	5	56
	18-60	10-18	1.20-1.70	0.6-2.0	0.17-0.22	Low	0.0-3.0	.43	.43			
Eckman	0-8	12-18	1.10-1.25	0.6-2.0	0.20-0.24	Low	2.0-6.0	.28	.28	5	5	56
	8-19	10-18	1.20-1.60	0.6-2.0	0.17-0.22	Low	0.0-3.0	.43	.43			
	19-60	10-18	1.20-1.70	0.6-2.0	0.14-0.22	Low	0.0-0.5	.43	.43			
881:												
Hamerly	0-10	18-27	1.30-1.60	0.6-2.0	0.18-0.24	Moderate	4.0-7.0	.28	.28	5	4L	86
	10-29	18-35	1.30-1.60	0.2-2.0	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	29-60	18-35	1.30-1.60	0.2-2.0	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Tonka	0-17	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	5.0-10	.37	.37	5	6	48
	17-40	35-45	1.40-1.65	<0.06-0.2	0.14-0.20	High	1.0-3.0	.43	.43			
	40-60	18-39	1.40-1.70	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
884:												
Hamerly	0-10	18-27	1.30-1.60	0.6-2.0	0.18-0.24	Moderate	4.0-7.0	.28	.28	5	4L	86
	10-29	18-35	1.30-1.60	0.2-2.0	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	29-60	18-35	1.30-1.60	0.2-2.0	0.15-0.19	Moderate	0.0-0.5	.37	.37			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
884:(con't)												
Wyard	0-15	18-27	1.00-1.30	0.6-2.0	0.20-0.24	Moderate	4.0-8.0	.28	.28	5	6	48
	15-21	18-27	1.20-1.30	0.6-2.0	0.20-0.22	Moderate	3.0-5.0	.32	.43			
	21-35	18-35	1.20-1.40	0.6-2.0	0.18-0.22	Moderate	1.0-3.0	.32	.43			
	35-60	15-35	1.30-1.60	0.6-2.0	0.14-0.22	Moderate	0.0-0.5	.37	.43			
893:												
Harriet	0-2	12-25	1.10-1.40	0.6-2.0	0.20-0.24	Low	3.0-6.0	.37	.37	2	6	48
	2-10	35-50	1.20-1.60	0.06-0.2	0.10-0.15	High	1.0-3.0	.37	.37			
	10-60	18-40	1.20-1.60	0.6-2.0	0.10-0.15	Moderate	0.5-1.0	.37	.37			
988:												
Heimdal	0-7	10-20	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-5.0	.28	.28	5	5	56
	7-14	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	14-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
Emrick	0-13	10-18	1.30-1.60	0.6-2.0	0.20-0.24	Low	4.0-9.0	.28	.28	5	5	56
	13-32	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	32-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
998:												
Heimdal	0-7	10-20	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-5.0	.28	.28	5	5	56
	7-14	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	14-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
Esmond	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	Low	1.0-3.0	.28	.28	5	4L	86
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	Low	0.0-1.0	.37	.43			
1001:												
Heimdal	0-7	10-20	1.30-1.60	0.6-2.0	0.20-0.24	Low	3.0-5.0	.28	.28	5	5	56
	7-14	10-18	1.30-1.60	0.6-2.0	0.17-0.19	Low	1.0-4.0	.28	.28			
	14-60	7-18	1.40-1.60	0.6-2.0	0.11-0.21	Low	0.0-2.0	.37	.43			
Esmond	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	Low	1.0-3.0	.28	.28	5	4L	86
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	Low	0.0-1.0	.37	.43			
1015:												
Kensal	0-9	18-25	1.10-1.40	0.6-2.0	0.20-0.22	Low	4.0-7.0	.28	.28	4	5	56
	9-23	18-25	1.20-1.50	0.6-2.0	0.15-0.19	Low	1.0-4.0	.28	.28			
	23-60	0-10	1.30-1.60	6.0->20	0.02-0.07	Low	0.0-0.5	.15	.49			
1062:												
LaDelle	0-23	27-35	1.15-1.30	0.2-0.6	0.18-0.22	Moderate	4.0-8.0	.28	.28	5	7	38
	23-43	27-35	1.20-1.35	0.2-0.6	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	43-60	25-35	1.30-1.40	0.2-0.6	0.16-0.20	Moderate	0.0-2.0	.28	.28			
1108:												
Larson	0-8	10-27	1.10-1.40	0.6-2.0	0.16-0.24	Moderate	2.0-5.0	.32	.32	2	5	56
	8-21	18-35	1.30-1.60	<0.06-0.2	0.10-0.14	Moderate	1.0-2.0	.32	.32			
	21-60	10-35	1.30-1.60	0.2-2.0	0.12-0.16	Moderate	0.0-0.5	.37	.37			
Cathay	0-10	10-27	1.10-1.40	0.6-2.0	0.20-0.23	Low	2.0-5.0	.32	.32	5	5	56
	10-22	18-35	1.40-1.60	<0.06-0.6	0.16-0.19	Moderate	0.5-2.0	.32	.32			
	22-60	7-18	1.40-1.60	0.2-2.0	0.17-0.19	Moderate	0.0-0.5	.32	.32			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
1188:												
Ludden	0-35	40-60	1.10-1.30	<0.06-0.2	0.16-0.18	High	4.0-9.0	.28	.28	5	4	86
	35-42	40-60	1.20-1.50	<0.06-0.2	0.13-0.16	High	0.5-3.0	.28	.28			
	42-60	35-60	1.20-1.50	<0.06-0.2	0.13-0.16	High	0.0-0.5	.32	.32			
1189:												
Ludden, saline	0-35	40-60	1.10-1.30	<0.06-0.2	0.12-0.14	High	4.0-8.0	.28	.28	5	4	86
	35-42	40-60	1.20-1.50	<0.06-0.2	0.06-0.08	High	0.5-3.0	.28	.28			
	42-60	35-60	1.20-1.50	<0.06-0.2	0.06-0.08	High	0.0-0.5	.32	.32			
1221:												
Maddock	0-11	2-10	1.20-1.40	2.0->20	0.10-0.12	Low	1.0-2.0	.17	.17	5	2	134
	11-60	2-8	1.30-1.50	2.0->20	0.05-0.12	Low	0.0-0.5	.17	.17			
Hecla	0-10	2-10	1.10-1.35	2.0->20	0.10-0.12	Low	1.0-3.0	.17	.17	5	2	134
	10-32	2-10	1.30-1.50	2.0->20	0.06-0.13	Low	1.0-3.0	.17	.17			
	32-60	3-8	1.35-1.60	2.0->20	0.05-0.12	Low	0.0-1.0	.17	.17			
1267:												
Marysland	0-8	18-35	1.10-1.30	0.6-2.0	0.17-0.24	Moderate	5.0-8.0	.28	.28	4	4L	86
	8-30	18-35	1.35-1.50	0.2-2.0	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	30-60	1-5	1.45-1.65	6.0->20	0.02-0.07	Low	0.0-0.5	.10	.10			
1268:												
Marysland, wet	0-8	18-30	1.20-1.30	0.6-2.0	0.17-0.22	Moderate	5.0-8.0	.28	.28	4	4L	86
	8-30	18-30	1.35-1.50	0.6-2.0	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	30-60	1-5	1.55-1.65	6.0->20	0.02-0.07	Low	0.0-0.5	.15	.15			
1427:												
Parnell	0-9	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	9-49	35-60	1.20-1.40	<0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	49-60	35-45	1.30-1.50	<0.06-0.2	0.11-0.19	High	0.5-1.0	.28	.28			
1454:												
Wyndmere	0-9	5-15	1.30-1.60	2.0-6.0	0.13-0.18	Low	5.0-8.0	.20	.20	5	3	86
	9-28	0-10	1.30-1.70	2.0-6.0	0.12-0.17	Low	1.0-5.0	.20	.20			
	28-42	0-10	1.30-1.70	2.0-6.0	0.06-0.16	Low	0.0-1.0	.20	.20			
	42-60	18-35	1.30-1.60	0.2-2.0	0.14-0.22	Moderate	0.0-1.0	.28	.32			
1466:												
Pits, sand and gravel	0-6	5-15	1.20-1.60	6.0->20	0.01-0.04	Low	0.5-1.0	.10	.20	2	8	0
	6-60	0-15	1.20-1.60	6.0->20	0.01-0.04	Low	0.0-0.5	.10	.17			
1710:												
Southam	0-10	27-40	1.10-1.40	0.2-0.6	0.18-0.23	Moderate	5.0-15	.37	.37	5	4L	86
	10-48	35-50	1.20-1.50	<0.06-0.2	0.14-0.20	High	1.0-10	.28	.28			
	48-60	18-50	1.20-1.50	<0.06-0.6	0.13-0.17	High	0.0-3.0	.28	.28			
1762:												
Svea	0-18	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.32	5	6	48
	18-28	18-35	1.30-1.50	0.2-2.0	0.15-0.22	Moderate	2.0-5.0	.28	.32			
	28-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-2.0	.37	.43			
Barnes	0-9	15-27	1.10-1.50	0.6-2.0	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			

Table 20.—Physical Properties of the Soils--(continued)

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Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
1765:												
Svea	0-18	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.32	5	6	48
	18-28	18-35	1.30-1.50	0.2-2.0	0.15-0.22	Moderate	2.0-5.0	.28	.32			
	28-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-2.0	.37	.43			
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
1766:												
Svea	0-18	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.32	5	6	48
	18-28	18-35	1.30-1.50	0.2-2.0	0.15-0.22	Moderate	2.0-5.0	.28	.32			
	28-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-2.0	.37	.43			
Buse	0-7	18-27	1.10-1.50	0.2-0.6	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	7-60	18-35	1.30-1.65	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
1769:												
Svea	0-18	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.32	5	6	48
	18-28	18-35	1.30-1.50	0.2-2.0	0.15-0.22	Moderate	2.0-5.0	.28	.32			
	28-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-2.0	.37	.43			
Cresbard	0-12	20-26	1.15-1.30	0.6-2.0	0.17-0.20	Low	2.0-5.0	.32	.32	5	6	48
	12-25	35-50	1.20-1.35	<0.06-0.6	0.11-0.14	High	0.5-2.0	.32	.32			
	25-32	35-50	1.20-1.35	<0.06-0.6	0.11-0.15	High	0.0-0.5	.32	.32			
	32-60	25-35	1.40-1.60	0.2-0.6	0.16-0.20	Moderate	0.0-0.5	.32	.32			
1781:												
Swenoda	0-13	10-20	1.10-1.35	2.0-6.0	0.13-0.18	Low	3.0-7.0	.20	.20	5	3	86
	13-33	10-18	1.30-1.45	2.0-6.0	0.10-0.17	Low	1.0-3.0	.20	.20			
	33-60	20-35	1.35-1.65	0.2-2.0	0.16-0.22	Moderate	0.0-1.0	.37	.37			
1843:												
Towner	0-16	2-10	1.20-1.40	6.0->20	0.08-0.12	Low	1.0-3.0	.17	.17	5	2	134
	16-35	2-10	1.20-1.40	6.0->20	0.06-0.13	Low	0.0-1.0	.17	.17			
	35-60	18-40	1.30-1.60	0.2-2.0	0.14-0.22	Moderate	0.0-0.5	.43	.43			
1883:												
Vallers	0-12	18-27	1.20-1.35	0.6-2.0	0.22-0.24	Low	5.0-8.0	.28	.28	5	4L	86
	12-32	18-35	1.40-1.55	0.2-0.6	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	32-60	18-35	1.50-1.70	0.2-0.6	0.17-0.19	Low	0.0-1.0	.28	.28			
Parnell	0-9	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	9-49	35-60	1.20-1.40	<0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	49-60	35-45	1.30-1.50	<0.06-0.2	0.11-0.19	High	0.5-1.0	.28	.28			
1886:												
Hamerly	0-10	18-27	1.20-1.30	0.6-2.0	0.13-0.16	Low	3.0-6.0	.28	.28	5	4L	86
	10-29	18-35	1.30-1.60	0.2-2.0	0.10-0.13	Moderate	1.0-3.0	.28	.28			
	29-60	18-35	1.30-1.60	0.2-2.0	0.10-0.13	Moderate	0.0-1.0	.37	.37			
Vallers	0-12	18-27	1.10-1.40	0.6-2.0	0.14-0.16	Low	5.0-8.0	.24	.24	5	4L	86
	12-32	18-35	1.30-1.50	0.2-2.0	0.10-0.13	Moderate	1.0-3.0	.28	.28			
	32-60	18-35	1.30-1.60	0.2-2.0	0.11-0.13	Moderate	0.0-1.0	.37	.37			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
								K	Kf	T		
	In	Pct	g/cc	in/hour	In/in		Pct					
1970:												
Walum	0-16	8-18	1.20-1.40	2.0-6.0	0.13-0.15	Low	2.0-4.0	.20	.20	3	3	86
	16-30	5-18	1.20-1.50	6.0->20	0.06-0.11	Low	0.0-2.0	.20	.24			
	30-60	0-10	1.40-1.70	6.0->20	0.02-0.04	Low	0.0-0.5	.10	—			
1978:												
Water	—	—	—	—	—	—	—	—	—	-	—	—
2118:												
Fram	0-18	10-18	1.30-1.60	0.6-2.0	0.20-0.24	Low	4.0-7.0	.28	.28	5	4L	86
	18-60	7-18	1.40-1.60	0.6-2.0	0.13-0.20	Low	0.0-4.0	.37	.37			
Tonka	0-17	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	5.0-10	.37	.37	5	6	48
	17-40	35-45	1.40-1.65	<0.06-0.2	0.14-0.20	High	1.0-3.0	.43	.43			
	40-60	18-39	1.40-1.70	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
2121:												
Ferney	0-5	18-26	1.15-1.30	0.6-2.0	0.18-0.20	Low	1.0-3.0	.32	.32	2	6	48
	5-13	35-50	1.40-1.60	<0.06-0.2	0.11-0.16	High	0.0-3.0	.32	.32			
	13-60	35-45	1.40-1.70	<0.06-0.2	0.11-0.16	High	0.0-1.0	.32	.32			
2151:												
Binford	0-8	6-18	1.10-1.35	2.0-6.0	0.13-0.15	Low	2.0-5.0	.20	.20	3	3	86
	8-17	6-18	1.30-1.50	2.0-6.0	0.12-0.19	Low	1.0-2.0	.24	.24			
	17-60	2-8	1.50-1.65	6.0->20	0.02-0.04	Low	0.0-0.5	.10	.20			
Coe	0-8	6-18	1.25-1.35	2.0-6.0	0.13-0.15	Low	2.0-4.0	.20	.20	2	3	86
	8-60	2-8	1.35-1.65	6.0->20	0.02-0.04	Low	0.0-0.5	.10	.43			
2152:												
Coe	0-8	6-18	1.20-1.40	0.6-6.0	0.10-0.17	Low	1.0-2.0	.15	.32	2	8	0
	8-60	2-8	1.35-1.65	6.0->20	0.02-0.04	Low	0.0-0.5	.10	.43			
Binford	0-8	6-18	1.10-1.35	2.0-6.0	0.13-0.15	Low	2.0-5.0	.20	.20	3	3	86
	8-17	6-18	1.30-1.50	2.0-6.0	0.12-0.19	Low	1.0-2.0	.24	.24			
	17-60	2-8	1.50-1.65	6.0->20	0.02-0.04	Low	0.0-0.5	.10	.20			
2153:												
Edgeley	0-8	18-26	1.30-1.40	0.6-2.0	0.20-0.22	Low	3.0-7.0	.32	.32	3	6	48
	8-26	18-34	1.30-1.50	0.6-2.0	0.13-0.19	Moderate	0.0-2.0	.37	.37			
	26-60	—	—	<0.06-0.2	—	—	0.0-0.5	—	—			
Kloten	0-9	18-26	1.30-1.40	0.6-2.0	0.17-0.22	Moderate	3.0-6.0	.32	.32	2	6	48
	9-60	—	—	<0.06-0.2	—	—	—	—	—			
Esmond	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	Low	1.0-4.0	.28	.28	5	4L	86
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	Low	—	.37	.43			
2156:												
Lamoure	0-9	20-26	1.10-1.25	0.2-2.0	0.19-0.22	Low	4.0-8.0	.28	.28	5	4L	86
	9-30	20-34	1.20-1.35	0.2-2.0	0.17-0.20	Moderate	1.0-3.0	.32	.32			
	30-60	20-34	1.20-1.35	0.2-2.0	0.17-0.20	Moderate	0.5-1.0	.43	.43			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
2156:(con't)												
Rauville	0-28	15-26	0.85-1.10	0.6-2.0	0.19-0.22	Low	4.0-10	.28	.28	5	4L	86
	28-60	20-45	1.10-1.30	0.2-2.0	0.17-0.20	Moderate	1.0-4.0	.32	.32			
2157:												
Maddock	0-11	2-10	1.20-1.40	2.0->20	0.10-0.12	Low	1.0-2.0	.17	.17	5	2	134
	11-60	2-8	1.30-1.50	2.0->20	0.05-0.12	Low	0.0-0.5	.17	.17			
Esmond	0-8	10-18	1.30-1.60	0.6-2.0	0.20-0.22	Low	1.0-4.0	.28	.28	5	4L	86
	8-60	7-18	1.40-1.60	0.6-2.0	0.14-0.22	Low	—	.37	.43			
Embden	0-16	10-18	1.40-1.60	2.0-6.0	0.13-0.18	Low	4.0-7.0	.20	.20	5	3	86
	16-38	10-18	1.40-1.60	2.0-6.0	0.12-0.17	Low	1.0-4.0	.20	.20			
	38-60	5-18	1.40-1.60	2.0-6.0	0.06-0.16	Low	0.0-1.0	.20	.20			
2158:												
Velva	0-15	7-18	1.20-1.50	0.6-6.0	0.13-0.22	Low	4.0-7.0	.20	.20	5	3	86
	15-60	7-18	1.30-1.60	0.6-6.0	0.16-0.22	Low	0.0-4.0	.20	.20			
2159:												
Walsh	0-8	27-35	1.10-1.30	0.6-2.0	0.17-0.23	Moderate	4.0-8.0	.28	.28	5	7	38
	8-60	25-35	1.20-1.40	0.2-2.0	0.14-0.22	Moderate	0.0-4.0	.43	.49			
2196:												
Bearden, saline	0-9	18-26	1.15-1.30	0.6-2.0	0.14-0.15	Moderate	3.0-7.0	.28	.28	5	4L	86
	9-20	18-34	1.30-1.45	0.2-2.0	0.10-0.14	Moderate	0.0-3.0	.43	.43			
	20-60	18-34	1.30-1.60	0.2-2.0	0.10-0.14	Moderate	0.0-1.0	.43	.43			
Colvin, saline	0-10	18-26	1.20-1.50	0.6-2.0	0.15-0.17	Moderate	4.0-7.0	.37	.37	5	4L	86
	10-60	18-34	1.30-1.50	0.2-2.0	0.11-0.15	Moderate	0.0-5.0	.37	.37			
2197:												
Edgeley	0-8	18-26	1.30-1.40	0.6-2.0	0.20-0.22	Low	3.0-7.0	.32	.32	3	6	48
	8-32	18-34	1.30-1.50	0.6-2.0	0.13-0.19	Moderate	0.0-2.0	.37	.37			
	32-60	—	—	<0.06-0.2	—	—	0.0-0.5	—	—			
Kloten	0-9	18-26	1.30-1.40	0.6-2.0	0.17-0.22	Moderate	3.0-6.0	.32	.32	2	6	48
	9-60	—	—	<0.06-0.2	—	—	—	—	—			
2198:												
Hamar	0-17	5-10	1.20-1.30	2.0->20	0.10-0.12	Low	1.0-3.0	.17	.17	5	2	134
	17-25	0-7	1.35-1.55	2.0->20	0.10-0.12	Low	0.0-2.0	.17	.17			
	25-60	0-7	1.45-1.65	2.0->20	0.06-0.08	Low	0.0-0.5	.17	.17			
Hecla	0-10	2-10	1.10-1.35	2.0->20	0.10-0.12	Low	1.0-3.0	.17	.17	5	2	134
	10-32	2-10	1.30-1.50	2.0->20	0.06-0.13	Low	1.0-3.0	.17	.17			
	32-60	3-8	1.35-1.60	2.0->20	0.05-0.12	Low	0.0-1.0	.17	.17			
2199:												
Hamerly	0-10	18-27	1.20-1.60	0.6-2.0	0.17-0.22	Moderate	3.0-6.0	.28	.37	5	8	0
	10-29	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	1.0-3.0	.28	.32			
	29-60	18-35	1.30-1.60	0.2-0.6	0.14-0.19	Moderate	0.0-1.0	.37	.43			
Barnes	0-9	18-26	1.20-1.60	0.6-2.0	0.20-0.22	Low	3.0-6.0	.17	.24	5	8	0
	9-14	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Low	2.0-5.0	.28	.28			
	14-60	18-35	1.30-1.60	0.2-0.6	0.14-0.19	Low	0.0-2.0	.37	.37			

Table 20.—Physical Properties of the Soils--(continued)

(The symbol< means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility index" apply only to the surface layer. Dashes(—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	in/hour	In/in		Pct					
2199:(con't)												
Tonka	0-17	18-27	1.10-1.30	0.6-2.0	0.20-0.24	Low	5.0-10	.37	.37	5	6	48
	17-40	35-45	1.40-1.65	<0.06-0.2	0.14-0.20	High	1.0-3.0	.43	.43			
	40-60	18-39	1.40-1.70	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.37			
2200:												
Letcher	0-8	5-10	1.25-1.35	0.6-2.0	0.11-0.17	Low	2.0-4.0	.20	.20	2	3	86
	8-9	10-18	1.25-1.35	0.6-6.0	0.10-0.15	Low	0.5-2.0	.20	.20			
	9-28	10-15	1.25-1.35	<0.06-0.2	0.08-0.14	Low	0.5-2.0	.20	.20			
	28-60	10-15	1.30-1.45	0.6-6.0	0.11-0.18	Low	0.0-0.5	.24	.24			
Swenoda	0-13	10-20	1.10-1.35	2.0-6.0	0.13-0.18	Low	3.0-7.0	.20	.20	5	3	86
	13-33	10-18	1.30-1.45	2.0-6.0	0.10-0.17	Low	1.0-3.0	.20	.20			
	33-60	20-35	1.35-1.65	0.2-2.0	0.16-0.22	Moderate	0.0-1.0	.37	.37			
2201:												
Stirum	0-8	10-20	1.40-1.50	2.0-6.0	0.10-0.13	Low	3.0-6.0	.20	.20	2	3	86
	8-23	10-25	1.40-1.60	0.2-0.6	0.12-0.18	Low	0.5-2.0	.24	.24			
	23-60	5-20	1.40-1.50	0.6->20	0.06-0.18	Low	0.0-0.5	.17	.17			
Arveson, saline	0-9	10-20	1.25-1.40	2.0-6.0	0.08-0.10	Low	5.0-8.0	.17	.17	4	3	86
	9-39	10-27	1.40-1.55	0.6-6.0	0.10-0.11	Low	1.0-5.0	.24	.24			
	39-60	5-20	1.50-1.65	2.0->20	0.03-0.10	Low	0.0-1.0	.17	.17			
2202:												
Swenoda	0-7	10-20	1.10-1.35	2.0-6.0	0.13-0.18	Low	3.0-7.0	.20	.20	5	3	86
	7-19	10-18	1.30-1.45	2.0-6.0	0.10-0.17	Low	1.0-3.0	.20	.20			
	19-37	20-35	1.35-1.65	0.2-2.0	0.16-0.22	Moderate	0.0-1.0	.37	.37			
	37-60	20-35	1.35-1.65	0.2-2.0	0.16-0.22	Moderate	0.0-1.0	.37	.37			
Barnes	0-7	10-20	1.20-1.60	2.0-6.0	0.13-0.15	Low	3.0-6.0	.20	.24	5	3	86
	7-19	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.32			
	19-37	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.43			
	37-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-0.5	.37	.43			
2203:												
Swenoda	0-13	10-20	1.10-1.35	2.0-6.0	0.13-0.18	Low	3.0-7.0	.20	.20	5	3	86
	13-33	10-18	1.30-1.45	2.0-6.0	0.10-0.17	Low	1.0-3.0	.20	.20			
	33-60	20-35	1.35-1.65	0.2-2.0	0.16-0.22	Moderate	0.0-1.0	.37	.37			
Barnes	0-7	10-20	1.20-1.60	2.0-6.0	0.13-0.15	Low	3.0-6.0	.20	.24	5	3	86
	7-19	18-35	1.20-1.60	0.6-2.0	0.15-0.19	Moderate	2.0-5.0	.28	.32			
	19-37	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-1.0	.37	.43			
	37-60	18-35	1.30-1.60	0.2-2.0	0.14-0.19	Moderate	0.0-0.5	.37	.43			
2204:												
Walsh	0-8	27-35	1.10-1.30	0.6-2.0	0.17-0.23	Moderate	4.0-8.0	.28	.28	5	7	38
	8-60	25-35	1.20-1.40	0.2-2.0	0.14-0.22	Moderate	0.0-4.0	.43	.49			
2205:												
Zell	0-8	10-18	1.15-1.30	0.6-2.0	0.20-0.24	Low	2.0-4.0	.32	.32	5	4L	86
	8-20	10-18	1.30-1.35	0.6-2.0	0.16-0.22	Low	0.5-2.0	.43	.43			
	20-60	5-18	1.30-1.50	0.6-2.0	0.15-0.22	Low	0.0-0.5	.43	.43			
Eckman	0-8	12-18	1.10-1.25	0.6-2.0	0.20-0.24	Low	2.0-6.0	.28	.28	5	5	56
	8-19	10-18	1.20-1.60	0.6-2.0	0.17-0.22	Low	0.0-3.0	.43	.43			
	19-60	10-18	1.20-1.70	0.6-2.0	0.14-0.22	Low	0.0-0.5	.43	.43			

Table 21.—Chemical Properties of the Soils

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
61:								
Arveson	0-9	10-20	15-30	7.4-8.4	5-20	---	0	0
	9-39	10-27	5.0-25	7.4-8.4	15-30	---	0	0
	39-60	5-20	2.0-15	7.4-8.4	10-20	---	0	0-1
118:								
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
120:								
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
156:								
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0
Svea	0-18	18-27	15-30	6.1-7.8	0	0	0	0
	18-28	18-35	10-30	6.6-7.8	0-3	0	0	0
	28-60	18-35	10-25	7.4-8.4	3-15	0-1	0.0-4.0	0-2
167:								
Bearden	0-9	18-26	15-30	7.4-8.4	0-10	0-1	0.0-4.0	0-2
	9-20	18-34	5.0-25	7.4-8.4	10-45	0-1	0.0-4.0	0-3
	20-60	18-34	5.0-20	7.4-8.4	5-20	0-5	0.0-4.0	0-10
296:								
Brantford	0-8	10-19	10-25	6.1-7.8	0	0	0	0
	8-15	18-27	10-20	6.6-7.8	0-1	0	0	0
	15-60	2-8	1.0-5.0	7.4-8.4	5-20	0	0	0
314:								
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0
319:								
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
391:								
Cavour	0-10	18-25	15-30	6.1-7.8	0	---	0.0-2.0	0
	10-20	35-50	25-45	6.6-9.0	0-10	---	4.0-16.0	5-15
	20-60	25-35	15-30	7.4-9.0	10-30	---	8.0-16.0	5-10
Cresbard	0-12	20-26	15-30	5.6-7.3	0	0	0.0-2.0	0
	12-25	35-50	20-45	5.6-7.8	0	0	2.0-4.0	1-10
	25-32	35-50	20-40	6.1-8.4	10-20	1-5	2.0-4.0	5-15
	32-60	25-35	15-30	7.4-9.0	10-20	1-5	2.0-8.0	5-15
450:								
Colvin	0-10	18-26	15-30	6.6-8.4	0-10	0-1	0.0-4.0	0-2
	10-30	18-34	5.0-30	7.4-8.4	10-45	0-1	0.0-4.0	0-3
	30-60	18-34	5.0-20	7.4-8.4	5-20	0-5	0.0-4.0	0-10
511:								
Divide	0-9	15-27	10-30	7.4-8.4	1-15	0	0	0
	9-28	18-35	10-30	7.4-8.4	15-35	0-1	0.0-2.0	0
	28-60	1-10	2.0-10	7.4-8.4	10-30	0	0	0
536:								
Eckman	0-8	12-18	10-25	6.6-7.8	0-3	0	0	0
	8-19	10-18	4.0-15	6.6-8.4	0-15	0	0	0
	19-60	10-18	4.0-10	7.4-8.4	0-15	0	0	0
Zell	0-8	10-18	10-20	6.6-8.4	0-5	0	0.0-2.0	0
	8-20	10-18	5.0-15	7.4-8.4	10-20	0	0.0-2.0	0
	20-60	5-18	2.0-10	7.4-8.4	5-15	0	0.0-2.0	0
539:								
Edgeley	0-8	18-26	15-35	6.1-7.3	0	0	0	0
	8-32	18-34	15-25	6.1-8.4	0-15	0	0	0
	32-60	---	---	---	---	---	---	---
541:								
Edgeley	0-8	18-26	15-27	6.1-7.3	0	0	0	0
	8-32	18-34	10-16	6.1-8.4	0-15	0	0	0
	32-60	---	---	---	---	---	---	---
569:								
Embden	0-16	10-18	10-25	6.6-7.3	0	0	0	0
	16-38	10-18	5.0-20	6.6-7.8	0	0	0	0
	38-60	5-18	2.0-15	6.6-8.4	0-15	0	0.0-2.0	0
579:								
Embden	0-16	10-18	10-25	6.6-7.3	0	0	0	0
	16-38	10-18	5.0-20	6.6-7.8	0	0	0	0
	38-60	5-18	2.0-15	6.6-8.4	0-15	0	0.0-2.0	0
Egeland	0-9	10-18	10-15	5.6-7.3	0	0	0.0-2.0	0
	9-40	10-18	5.0-15	6.1-7.8	0	0	0.0-2.0	0
	40-60	5-10	2.0-5.0	6.6-8.4	0-10	0-1	0.0-2.0	0
595:								
Emrick	0-13	10-18	10-30	6.6-7.8	0	0	0	0
	13-32	10-18	5.0-20	6.6-7.8	0-5	0	0	0
	32-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
595:(con't)								
Cathay	0-10	10-27	10-25	6.1-7.8	0	---	0.0-2.0	0
	10-22	18-35	10-25	6.6-8.4	0	---	4.0-8.0	1-10
	22-60	7-18	3.0-10	7.4-9.0	5-20	---	4.0-8.0	5-15
597:								
Emrick	0-13	10-18	10-30	6.6-7.8	0	0	0	0
	13-32	10-18	5.0-20	6.6-7.8	0-5	0	0	0
	32-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5
Heimdal	0-7	10-20	20-30	6.1-7.3	0	0	0	0
	7-14	10-18	10-25	6.1-7.8	0-5	0	0	0-1
	14-60	7-18	5.0-20	7.4-8.4	5-20	0	0	0-5
605:								
Esmond	0-8	10-18	5.0-15	7.4-8.4	0	---	0	0
	8-60	7-18	3.0-15	7.4-8.4	5-20	---	0	0
Heimdal	0-7	10-20	20-30	6.1-7.3	0	0	0	0
	7-14	10-18	10-25	6.1-7.8	0-5	0	0	0-1
	14-60	7-18	5.0-20	7.4-8.4	5-20	0	0	0-5
753:								
Fram	0-18	10-18	10-25	7.4-8.4	0-25	---	0	---
	18-60	7-18	5.0-20	7.4-8.4	15-30	---	0	---
Wyard	0-15	18-27	15-30	6.6-7.8	0	0	0	0
	15-21	18-27	15-25	6.6-7.8	0	0	0	0
	21-35	18-35	10-25	7.4-8.4	10-25	0	0	0
	35-60	15-35	5.0-20	7.4-8.4	10-20	0	0	0
769:								
Gardena	0-18	12-18	10-25	6.6-7.8	0-3	0	0	0
	18-60	10-18	5.0-15	7.4-8.4	0-15	0-2	0.0-2.0	0-2
773:								
Gardena	0-18	12-18	10-25	6.6-7.8	0-3	0	0	0
	18-60	10-18	5.0-15	7.4-8.4	0-15	0-2	0.0-2.0	0-2
Eckman	0-8	12-18	10-25	6.6-7.8	0-3	0	0	0
	8-19	10-18	4.0-15	6.6-8.4	0-15	0	0	0
	19-60	10-18	4.0-10	7.4-8.4	0-15	0	0	0
881:								
Hamerly	0-10	18-27	15-30	6.6-8.4	1-10	0	0.0-2.0	0
	10-29	18-35	10-20	7.4-8.4	10-30	0-2	0.0-4.0	0-2
	29-60	18-35	10-20	7.4-8.4	5-25	0-2	0.0-4.0	0-2
Tonka	0-17	18-27	20-40	5.6-7.8	0	0	0	0
	17-40	35-45	25-40	5.6-7.8	0-1	0-1	0.0-2.0	0-1
	40-60	18-39	10-35	6.6-8.4	5-20	0-2	0.0-4.0	0-2
884:								
Hamerly	0-10	18-27	15-30	6.6-8.4	1-10	0	0.0-2.0	0
	10-29	18-35	10-20	7.4-8.4	10-30	0-2	0.0-4.0	0-2
	29-60	18-35	10-20	7.4-8.4	5-25	0-2	0.0-4.0	0-2

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
884:(con't)								
Wyard	0-15	18-27	15-30	6.6-7.8	0	0	0	0
	15-21	18-27	15-25	6.6-7.8	0	0	0	0
	21-35	18-35	10-25	7.4-8.4	10-25	0	0	0
	35-60	15-35	5.0-20	7.4-8.4	10-20	0	0	0
893:								
Harriet	0-2	12-25	13-30	6.6-8.4	0	0	0.0-2.0	0
	2-10	35-50	17-45	7.4-9.0	1-45	0-5	4.0-16.0	13-25
	10-60	18-40	10-35	7.9-9.0	10-45	0-5	4.0-16.0	5-20
988:								
Heimdal	0-7	10-20	10-20	6.1-7.3	0	0	0	0
	7-14	10-18	5.0-20	6.1-7.8	0-5	0	0	0-1
	14-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5
Emrick	0-13	10-18	10-30	6.6-7.8	0	0	0	0
	13-32	10-18	5.0-20	6.6-7.8	0-5	0	0	0
	32-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5
998:								
Heimdal	0-7	10-20	10-20	6.1-7.3	0	0	0	0
	7-14	10-18	5.0-20	6.1-7.8	0-5	0	0	0-1
	14-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5
Esmond	0-8	10-18	5.0-15	7.4-8.4	0	---	0	---
	8-60	7-18	3.0-15	7.4-8.4	5-20	---	0	---
1001:								
Heimdal	0-7	10-20	10-20	6.1-7.3	0	0	0	0
	7-14	10-18	5.0-20	6.1-7.8	0-5	0	0	0-1
	14-60	7-18	3.0-15	7.4-8.4	5-20	0	0	0-5
Esmond	0-8	10-18	5.0-15	7.4-8.4	0	---	0	0
	8-60	7-18	3.0-15	7.4-8.4	5-20	---	0	0
1015:								
Kensal	0-9	18-25	15-30	6.6-7.3	0	---	0	0
	9-23	18-25	10-25	6.6-7.3	0-15	---	0	0
	23-60	0-10	0.0-5.0	7.4-8.4	5-20	---	0	0
1062:								
LaDelle	0-23	27-35	20-35	6.6-7.8	0	---	0	0
	23-43	27-35	15-30	7.4-8.4	4-25	---	0.0-4.0	---
	43-60	25-35	10-25	7.4-8.4	4-15	0-2	0.0-4.0	0-1
1108:								
Larson	0-8	10-27	10-25	6.1-7.3	0	0	0.0-2.0	0
	8-21	18-35	10-25	7.4-9.0	1-10	0-2	4.0-16.0	5-15
	21-60	10-35	5.0-20	7.9-9.0	10-35	0-4	2.0-8.0	5-10
Cathay	0-10	10-27	10-25	6.1-7.8	0	---	0.0-2.0	0
	10-22	18-35	10-25	6.6-8.4	0	---	4.0-8.0	1-10
	22-60	7-18	3.0-10	7.4-9.0	5-20	---	4.0-8.0	5-15

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
1188:								
Ludden	0-35	40-60	25-50	6.1-8.4	0-10	0	0.0-4.0	0
	35-42	40-60	20-30	7.9-8.4	5-20	0-2	0.0-4.0	0-2
	42-60	35-60	20-30	7.9-8.4	5-20	0-2	0.0-8.0	0-2
1189:								
Ludden, saline	0-35	40-60	30-65	6.1-8.4	0-10	0-2	4.0-8.0	0-2
	35-42	40-60	25-55	7.9-8.4	5-20	0-4	8.0-16.0	0-4
	42-60	35-60	20-50	7.9-8.4	5-20	0-4	8.0-16.0	0-4
1221:								
Maddock	0-11	2-10	3.0-10	6.6-7.8	0-3	0	0.0-2.0	0
	11-60	2-8	1.0-8.0	6.6-8.4	0-10	0	0.0-2.0	0
Hecla	0-10	2-10	3.0-10	6.1-7.8	0-3	0	0	0
	10-32	2-10	3.0-10	6.1-7.8	0-3	0	0	0
	32-60	3-8	1.0-8.0	6.1-8.4	0-10	0	0	0
1267:								
Marysland	0-8	18-35	15-35	7.9-8.4	1-15	0	0	0
	8-30	18-35	10-25	7.9-8.4	15-35	0-3	0.0-2.0	0
	30-60	1-5	2.0-10	7.9-8.4	5-20	0	0	0
1268:								
Marysland, wet	0-8	18-30	15-35	7.9-8.4	1-15	---	0	---
	8-30	18-30	10-25	7.9-8.4	15-35	---	0	---
	30-60	1-5	0.0-4.0	7.9-8.4	5-20	---	0	---
1427:								
Parnell	0-9	27-40	30-50	6.1-7.8	0	0	0	0
	9-49	35-60	25-60	6.1-7.8	0	0	0	0
	49-60	35-45	20-40	6.6-8.4	0-3	0-2	0	0
1454:								
Wyndmere	0-9	5-15	10-25	7.4-8.4	10-25	0-1	0	0-1
	9-28	0-10	2.0-15	7.4-8.4	15-40	0-1	0	0-1
	28-42	0-10	0.0-10	7.4-8.4	5-25	0-1	0	0-3
	42-60	18-35	5.0-25	7.4-8.4	5-25	0-1	0	0-3
1466:								
Pits, sand and gravel	0-6	5-15	2.0-12	6.6-8.4	0-3	0	0	0
	6-60	0-15	1.0-10	6.6-8.4	5-20	0	0	0
1710:								
Southam	0-10	27-40	25-60	6.6-8.4	0-10	0-1	2.0-8.0	0-2
	10-48	35-50	25-60	6.6-8.4	3-25	0-1	2.0-8.0	0-2
	48-60	18-50	10-45	7.4-8.4	10-30	0-5	2.0-8.0	0-2
1762:								
Svea	0-18	18-27	15-30	6.1-7.8	0	0	0	0
	18-28	18-35	10-30	6.6-7.8	0-3	0	0	0
	28-60	18-35	10-25	7.4-8.4	3-15	0-1	0.0-4.0	0-2
Barnes	0-9	15-27	10-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
1765:								
Svea	0-18	18-27	15-30	6.1-7.8	0	0	0	0
	18-28	18-35	10-30	6.6-7.8	0-3	0	0	0
	28-60	18-35	10-25	7.4-8.4	3-15	0-1	0.0-4.0	0-2
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
1766:								
Svea	0-18	18-27	15-30	6.1-7.8	0	0	0	0
	18-28	18-35	10-30	6.6-7.8	0-3	0	0	0
	28-60	18-35	10-25	7.4-8.4	3-15	0-1	0.0-4.0	0-2
Buse	0-7	18-27	10-30	6.6-8.4	1-10	0	0	0
	7-60	18-35	5.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
1769:								
Svea	0-18	18-27	15-30	6.1-7.8	0	0	0	0
	18-28	18-35	10-30	6.6-7.8	0-3	0	0	0
	28-60	18-35	10-25	7.4-8.4	3-15	0-1	0.0-4.0	0-2
Cresbard	0-12	20-26	15-30	5.6-7.3	0	0	0.0-2.0	0
	12-25	35-50	20-45	5.6-7.8	0	0	2.0-4.0	1-10
	25-32	35-50	20-40	6.1-8.4	10-20	1-5	2.0-4.0	5-15
	32-60	25-35	15-30	7.4-9.0	10-20	1-5	2.0-8.0	5-15
1781:								
Swenoda	0-13	10-20	10-25	6.1-7.3	0	0	0.0-2.0	0
	13-33	10-18	5.0-15	6.6-7.8	0	0	0.0-2.0	0
	33-60	20-35	2.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
1843:								
Towner	0-16	2-10	3.0-10	6.6-7.8	0	0	0	0
	16-35	2-10	1.0-10	6.6-7.8	0	0	0	0
	35-60	18-40	5.0-25	7.4-8.4	10-30	0-2	0.0-2.0	0
1883:								
Vallers	0-12	18-27	20-40	7.4-8.4	5-10	0-1	0.0-4.0	0
	12-32	18-35	10-30	7.4-8.4	15-30	0-2	0.0-4.0	0-5
	32-60	18-35	10-20	7.4-8.4	15-30	0-2	0.0-4.0	0-10
Parnell	0-9	27-40	30-50	6.1-7.8	0	0	0	0
	9-49	35-60	25-60	6.1-7.8	0	0	0	0
	49-60	35-45	20-40	6.6-8.4	0-3	0-2	0	0
1886:								
Hamerly, saline	0-10	18-27	15-30	7.4-8.4	1-15	0-3	4.0-16.0	0
	10-29	18-35	10-30	7.4-8.4	15-35	0-5	4.0-16.0	0-2
	29-60	18-35	10-25	7.4-8.4	10-30	0-5	4.0-16.0	0-4
Vallers, saline	0-12	18-27	15-30	7.4-8.4	5-10	0-1	4.0-16.0	0-3
	12-32	18-35	10-25	7.4-8.4	15-35	0-3	4.0-16.0	0-5
	32-60	18-35	10-20	7.4-8.4	15-30	0-3	4.0-16.0	0-10
1970:								
Walum	0-16	8-18	5.0-15	6.6-7.3	0	---	0	---
	16-30	5-18	2.0-15	6.6-7.3	0-15	---	0	---
	30-60	0-10	0.0-5.0	7.4-8.4	5-20	---	0	---

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
1978:								
Water	---	---	---	---	---	---	---	---
2118:								
Fram	0-18	10-18	10-25	7.4-8.4	0-25	---	0	---
	18-60	7-18	5.0-20	7.4-8.4	15-30	---	0	---
Tonka	0-17	18-27	20-40	5.6-7.8	0	0	0	0
	17-40	35-45	25-40	5.6-7.8	0-1	0-1	0.0-2.0	0-1
	40-60	18-39	10-35	6.6-8.4	5-20	0-2	0.0-4.0	0-2
2121:								
Ferney	0-5	18-26	15-35	6.1-7.3	0	0	0.0-2.0	0-3
	5-13	35-50	20-45	6.6-8.4	0-1	1-3	4.0-16.0	16-21
	13-60	35-45	20-40	7.4-9.0	2-15	1-5	8.0-16.0	8-16
2151:								
Binford	0-8	6-18	5.0-20	5.6-7.8	0	0	0	0
	8-17	6-18	5.0-15	5.6-8.4	0-1	0	0	0
	17-60	2-8	1.0-5.0	7.4-8.4	5-20	0	0	0
Coe	0-8	6-18	5.0-15	6.6-7.8	0-5	0	0	0
	8-60	2-8	1.0-5.0	7.4-8.4	5-20	0	0	0
2152:								
Coe	0-8	6-18	5.0-15	6.6-7.8	0-5	0	0	0
	8-60	2-8	1.0-5.0	7.4-8.4	5-20	0	0	0
Binford	0-8	6-18	5.0-20	5.6-7.8	0	0	0	0
	8-17	6-18	5.0-15	5.6-8.4	0-1	0	0	0
	17-60	2-8	1.0-5.0	7.4-8.4	5-20	0	0	0
2153:								
Edgeley	0-8	18-26	15-27	6.1-7.3	0	0	0	0
	8-26	18-34	10-16	6.1-8.4	0-15	0	0	0
	26-60	---	---	---	---	---	---	---
Kloten	0-9	18-26	15-25	6.1-8.4	0-5	0	0	0
	9-60	---	10-25	---	---	---	---	---
Esmond	0-8	10-18	---	7.4-8.4	---	---	0	---
	8-60	7-18	---	7.4-8.4	---	---	0	---
2156:								
Lamoure	0-9	20-26	22-29	7.4-8.4	0-10	0	0.0-4.0	1-2
	9-30	20-34	24-31	7.4-8.4	9-20	0	0.0-4.0	1-3
	30-60	20-34	20-29	7.4-8.4	9-20	0-1	0.0-4.0	1-3
Rauville	0-28	15-26	15-35	7.4-8.4	5-15	0	0.0-2.0	1-2
	28-60	20-45	20-35	7.4-8.4	10-20	0-1	0.0-4.0	1-3
2157:								
Maddock	0-11	2-10	3.0-10	6.6-7.8	0-3	0	0.0-2.0	0
	11-60	2-8	1.0-8.0	6.6-8.4	0-10	0	0.0-2.0	0
Esmond	0-8	10-18	---	7.4-8.4	---	---	0	---
	8-60	7-18	---	7.4-8.4	---	---	0	---

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
2157:(con't)								
Embden	0-16	10-18	10-25	6.6-7.3	0	0	0	0
	16-38	10-18	5.0-20	6.6-7.8	0	0	0	0
	38-60	5-18	2.0-10	6.6-8.4	5-15	0	0	0
2158:								
Velva	0-15	7-18	10-25	6.6-7.3	0	0	0	0
	15-60	7-18	3.0-20	6.6-8.4	5-10	0	0	0
2159:								
Walsh	0-8	27-35	20-35	6.1-7.3	0	---	0	---
	8-60	25-35	10-30	6.1-7.8	0-15	---	0	---
2196:								
Bearden, saline	0-9	18-26	15-30	7.4-7.8	0-10	0-1	4.0-16.0	0-2
	9-20	18-34	5.0-25	7.4-8.4	10-45	0-5	4.0-16.0	0-3
	20-60	18-34	5.0-20	7.4-8.4	5-20	0-5	4.0-16.0	0-10
Colvin, saline	0-10	18-26	25-35	7.4-8.4	0-10	0-1	4.0-16.0	0-2
	10-60	18-34	10-25	7.4-8.4	5-45	0-5	4.0-16.0	0-10
2197:								
Edgeley	0-8	18-26	15-27	6.1-7.3	0	0	0	0
	8-32	18-34	10-16	6.1-8.4	0-15	0	0	0
	32-60	---	---	---	---	---	---	---
Kloten	0-9	18-26	15-25	6.1-8.4	0-5	0	0	0
	9-60	---	10-25	---	---	---	---	---
2198:								
Hamar	0-17	5-10	4.0-10	6.1-7.8	0	---	0.0-2.0	0
	17-25	0-7	0.0-10	6.6-8.4	0-1	---	0.0-2.0	0
	25-60	0-7	0.0-5.0	7.4-8.4	0-2	---	0.0-2.0	0
Hecla	0-10	2-10	3.0-10	6.1-7.8	0-3	0	0	0
	10-32	2-10	3.0-10	6.1-7.8	0-3	0	0	0
	32-60	3-8	1.0-8.0	6.1-8.4	0-10	0	0	0
2199:								
Hamerly	0-10	18-27	15-30	6.6-8.4	0-10	---	0	0
	10-29	18-35	10-25	7.4-8.4	10-30	---	0	0-2
	29-60	18-35	5.0-25	7.4-8.4	5-25	---	0	0-2
Barnes	0-9	18-26	15-30	5.6-7.8	0	0	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-5	0	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	0-2	0.0-4.0	0
Tonka	0-17	18-27	20-40	5.6-7.8	0	0	0	0
	17-40	35-45	25-40	5.6-7.8	0-1	0-1	0.0-2.0	0-1
	40-60	18-39	10-35	6.6-8.4	5-20	0-2	0.0-4.0	0-2
2200:								
Letcher	0-8	5-10	10-15	5.1-7.8	0	0	0.0-2.0	0
	8-9	10-18	10-16	5.1-7.8	0-7	0	0.0-2.0	1-7
	9-28	10-15	7.0-14	6.6-9.0	10-20	1-3	2.0-8.0	5-15
	28-60	10-15	7.0-14	7.4-9.0	5-15	1-3	2.0-8.0	5-15

Table 21.—Chemical Properties of the Soils--(continued)

Dashes(--) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm	
2200:(con't)								
Swenoda	0-13	10-20	10-25	6.1-7.3	0	0	0.0-2.0	0
	13-33	10-18	5.0-15	6.6-7.8	0	0	0.0-2.0	0
	33-60	20-35	2.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
2201:								
Stirum	0-8	10-20	10-25	7.4-8.4	1-10	0	2.0-8.0	0-2
	8-23	10-25	5.0-20	7.9-9.0	10-45	0-2	2.0-16.0	5-15
	23-60	5-20	2.0-15	7.9-9.0	10-45	0-4	2.0-16.0	5-10
Arveson, saline	0-9	10-20	15-30	7.4-8.4	5-20	0	4.0-16.0	0
	9-39	10-27	5.0-25	7.4-8.4	15-30	0-2	4.0-16.0	0
	39-60	5-20	2.0-25	7.4-8.4	10-20	0-4	4.0-16.0	0-1
2202:								
Swenoda	0-7	10-20	10-25	6.1-7.3	0	0	0.0-2.0	0
	7-19	10-18	5.0-15	6.6-7.8	0	0	0.0-2.0	0
	19-37	20-35	2.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
	37-60	20-35	2.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
Barnes	0-7	10-20	10-25	5.6-7.8	0	---	0.0-2.0	0
	7-19	18-35	10-30	6.1-7.8	0-3	---	0.0-4.0	0
	19-37	18-35	5.0-25	7.4-8.4	10-30	---	0.0-4.0	0
	37-60	18-35	5.0-20	7.4-8.4	10-30	---	0.0-4.0	0
2203:								
Swenoda	0-13	10-20	10-25	6.1-7.3	0	0	0.0-2.0	0
	13-33	10-18	5.0-15	6.6-7.8	0	0	0.0-2.0	0
	33-60	20-35	2.0-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
Barnes	0-9	10-20	10-25	5.6-7.8	0	---	0.0-2.0	0
	9-14	18-35	10-30	6.1-7.8	0-3	---	0.0-4.0	0
	14-60	18-35	5.0-25	7.4-8.4	10-30	---	0.0-4.0	0
2204:								
Walsh	0-8	27-35	20-35	6.1-7.3	0	---	0	---
	8-60	25-35	10-30	6.1-7.8	0-15	---	0	---
2205:								
Zell	0-8	10-18	10-20	6.6-8.4	0-5	0	0.0-2.0	0
	8-20	10-18	5.0-15	7.4-8.4	10-20	0	0.0-2.0	0
	20-60	5-18	2.0-10	7.4-8.4	5-15	0	0.0-2.0	0
Eckman	0-8	12-18	10-25	6.6-7.8	0-3	0	0	0
	8-19	10-18	4.0-15	6.6-8.4	0-15	0	0	0
	19-60	10-18	4.0-10	7.4-8.4	0-15	0	0	0

Table 22.—Water Features

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
61:									
Arveson	B/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
118:									
Barnes	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
Buse	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
120:									
Barnes	B								
		All months	---	---	---	---	---	---	---
Buse	B								
		All months	---	---	---	---	---	---	---
156:									
Barnes	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
Svea	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
167:									
Bearden	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
167:(con't)									
Bearden		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
296:									
Brantford	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
314:									
Buse	B								
		All months	---	---	---	---	---	---	---
Barnes	B								
		All months	---	---	---	---	---	---	---
319:									
Buse	B								
		All months	---	---	---	---	---	---	---
Barnes	B								
		All months	---	---	---	---	---	---	---
391:									
Cavour	D								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Cresbard	C								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
450:									
Colvin	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
511:									
Divide	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
536:									
Eckman	B								
		All months	---	---	---	---	---	---	---
Zell	B								
		All months	---	---	---	---	---	---	---
539:									
Edgeley	B								
		All months	---	---	---	---	---	---	---
541:									
Edgeley	C								
		All months	---	---	---	---	---	---	---
569:									
Embden	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table Upper limit	Water Table Lower limit	Ponding Surface water depth	Ponding Duration	Ponding Frequency	Flooding Duration	Flooding Frequency
579:									
Embden	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Egeland	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
595:									
Emrick	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Cathay	C								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
597:									
Emrick	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
597:(con't)									
Emrick		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Heimdal	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
605:									
Esmond	B								
		All months	---	---	---	---	---	---	---
Heimdal	B								
		All months	---	---	---	---	---	---	---
753:									
Fram	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Wyard	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
769:									
Gardena	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
769:(con't)									
Gardena		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
773:									
Gardena	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Eckman	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
881:									
Hamerly	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Tonka	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		April[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		June	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
884:									
Hamerly	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Wyard	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
893:									
Harriet	D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		May	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		June	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
988:									
Heimdal	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
Emrick	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
988:(con't)									
Emrick		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
998:									
Heimdal	B								
		All months	---	---	---	---	---	---	---
Esmond	B								
		All months	---	---	---	---	---	---	---
1001:									
Heimdal	B								
		All months	---	---	---	---	---	---	---
Esmond	B								
		All months	---	---	---	---	---	---	---
1015:									
Kensal	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1062:									
LaDelle	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	Brief	Occasional
		May	3.0-5.0	> 6.0	---	---	---	Brief	Occasional
		June	3.0-5.0	> 6.0	---	---	---	Brief	Occasional
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1108:									
Larson	D								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
1108:(con't)									
Larson		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Cathay	C								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1188:									
Ludden	D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		April	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		May	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		June	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		July	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
1189:									
Ludden, saline	D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		April	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		May	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		June	0.0-1.5	> 6.0	---	---	---	Long	Occasional
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
1221:									
Maddock	A								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table Upper limit	Water Table Lower limit	Ponding Surface water depth	Ponding Duration	Ponding Frequency	Flooding Duration	Flooding Frequency
1221:(con't)									
Hecla	A								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1267:									
Marysland	B/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
1268:									
Marysland, wet	B/D								
		January	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		February	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		March	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		April	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		May	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		June	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		July	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		August	0.5-1.0	> 6.0	0.0-0.0	---	---	---	---
		September	0.5-1.0	> 6.0	0.0-0.0	---	---	---	---
		October	0.5-1.0	> 6.0	0.0-0.0	---	---	---	---
		November	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
		December	0.0-1.0	> 6.0	0.0-1.0	Very long	---	---	---
1427:									
Parnell	C/D								
		January	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		February	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		March	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		April	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		May	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		June	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		July	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		August	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		September	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		October	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		November	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		December	0.0	> 6.0	0.0-2.0	Very long	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table Upper limit	Water Table Lower limit	Ponding Surface water depth	Ponding Duration	Ponding Frequency	Flooding Duration	Flooding Frequency
1454:									
Wyndmere	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
1466:									
Pits, sand and gravel	A								
		All months	---	---	---	---	---	---	---
1710:									
Southam	D								
		January	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		February	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		March	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		April	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		May	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		June	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		July	0.0	> 6.0	0.0-5.0	Very long	---	---	---
		August	0.0-1.0	> 6.0	0.0-5.0	Long	---	---	---
		September	0.0-1.0	> 6.0	0.0-5.0	Long	---	---	---
		October	0.0-1.0	> 6.0	0.0-5.0	Long	---	---	---
		November	0.0	> 6.0	0.0-5.0	Long	---	---	---
		December	0.0	> 6.0	0.0-5.0	Long	---	---	---
1762:									
Svea	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Barnes	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
1765:									
Svea	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
1765:(con't)									
Svea		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Buse	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
1766:									
Svea	B								
		All months	---	---	---	---	---	---	---
Buse	B								
		All months	---	---	---	---	---	---	---
1769:									
Svea	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
Cresbard	C								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1781:									
Swenoda	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
1781:(con't)									
Swenoda		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1843:									
Towner	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1883:									
Vallers	C								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
Parnell	C/D								
		January	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		February	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		March	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		April	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		May	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		June	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		July	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		August	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		September	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		October	0.0-1.5	> 6.0	0.0-2.0	Very long	---	---	---
		November	0.0	> 6.0	0.0-2.0	Very long	---	---	---
		December	0.0	> 6.0	0.0-2.0	Very long	---	---	---
1886:									
Hamerly, saline	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
1886:(con't)									
Hamerly, saline		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Vallers, saline	C								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
1970:									
Walum	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
1978:									
Water	---								
		January	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		February	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		March	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		April	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		May	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		June	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		July	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		August	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		September	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		October	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		November	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
		December	0.0	> 6.0	5.0-6.1	Very long	Frequent	---	---
2118:									
Fram	B								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
2118:(con't)									
Fram		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Tonka	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		April[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		June	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
2121:									
Ferney	D								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
2151:									
Binford	B								
		All months	---	---	---	---	---	---	---
Coe	A								
		All months	---	---	---	---	---	---	---
2152:									
Coe	A								
		All months	---	---	---	---	---	---	---
Binford	B								
		All months	---	---	---	---	---	---	---
2153:									
Edgeley	C								
		All months	---	---	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
2153:(con't)									
Kloten	D								
		All months	---	---	---	---	---	---	---
Esmond	B								
		All months	---	---	---	---	---	---	---
2156:									
Lamoure	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.5-1.5	> 6.0	---	---	---	Brief	Frequent
		April	0.5-1.5	> 6.0	---	---	---	Brief	Frequent
		May	0.5-1.5	> 6.0	---	---	---	Brief	Frequent
		June	0.5-1.5	> 6.0	---	---	---	Brief	Occasional
		July	0.5-1.5	> 6.0	---	---	---	Brief	Occasional
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
Rauville	D								
		January	0.0-1.0	> 6.0	---	---	---	---	---
		February	0.0-1.0	> 6.0	---	---	---	---	---
		March	0.0-1.0	> 6.0	---	---	---	Long	Frequent
		April	0.0-0.5	> 6.0	---	---	---	Long	Frequent
		May	0.0-0.5	> 6.0	---	---	---	Long	Frequent
		June	0.0-0.5	> 6.0	---	---	---	Long	Frequent
		July	0.0-0.5	> 6.0	---	---	---	Long	Frequent
		August	0.0-1.0	> 6.0	---	---	---	Long	Frequent
		September	0.0-1.0	> 6.0	---	---	---	Long	Frequent
		October	0.0-1.0	> 6.0	---	---	---	Long	Frequent
		November	0.0-1.0	> 6.0	---	---	---	---	---
		December	0.0-1.0	> 6.0	---	---	---	---	---
2157:									
Maddock	A								
		All months	---	---	---	---	---	---	---
Esmond	B								
		All months	---	---	---	---	---	---	---
Embden	B								
		All months	---	---	---	---	---	---	---
2158:									
Velva	B								
		March	---	---	---	---	---	Brief	Occasional
		April	4.0-6.0	> 6.0	---	---	---	Brief	Occasional
		May	4.0-6.0	> 6.0	---	---	---	Brief	Occasional
		June	4.0-6.0	> 6.0	---	---	---	Brief	Occasional
2159:									
Walsh	C								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
2196:									
Bearden, saline	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Colvin, saline	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
2197:									
Edgeley	C								
		All months	---	---	---	---	---	---	---
Kloten	D								
		All months	---	---	---	---	---	---	---
2198:									
Hamar	A/D								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Hecla	A								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro- logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
2198:(con't)									
Hecla		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
2199:									
Hamerly	C								
		January	3.0-5.0	> 6.0	---	---	---	---	---
		February	3.0-5.0	> 6.0	---	---	---	---	---
		March	3.0-5.0	> 6.0	---	---	---	---	---
		April	1.5-3.5	> 6.0	---	---	---	---	---
		May	1.5-3.5	> 6.0	---	---	---	---	---
		June	1.5-3.5	> 6.0	---	---	---	---	---
		July	3.0-5.0	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	3.0-5.0	> 6.0	---	---	---	---	---
		October	3.0-5.0	> 6.0	---	---	---	---	---
		November	3.0-5.0	> 6.0	---	---	---	---	---
		December	3.0-5.0	> 6.0	---	---	---	---	---
Barnes	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
Tonka	C/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		April[1]	0-0	1.0-1.5	0.0-1.0	Very long	---	---	---
			1.5-2.0	>6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		June	0.0-1.5	> 6.0	0.0-1.0	Very long	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	3.0-5.0	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
2200:									
Letcher	D								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
2200:(con't)									
Swenoda	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---
2201:									
Stirum	B/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
Arveson, saline	B/D								
		January	1.5-3.5	> 6.0	---	---	---	---	---
		February	1.5-3.5	> 6.0	---	---	---	---	---
		March	0.0-1.5	> 6.0	---	---	---	---	---
		April	0.0-1.5	> 6.0	---	---	---	---	---
		May	0.0-1.5	> 6.0	---	---	---	---	---
		June	0.0-1.5	> 6.0	---	---	---	---	---
		July	0.0-1.5	> 6.0	---	---	---	---	---
		August	1.5-3.5	> 6.0	---	---	---	---	---
		September	1.5-3.5	> 6.0	---	---	---	---	---
		October	1.5-3.5	> 6.0	---	---	---	---	---
		November	1.5-3.5	> 6.0	---	---	---	---	---
		December	1.5-3.5	> 6.0	---	---	---	---	---
2202:									
Swenoda	B								
		January	4.0-6.0	> 6.0	---	---	---	---	---
		February	4.0-6.0	> 6.0	---	---	---	---	---
		March	4.0-6.0	> 6.0	---	---	---	---	---
		April	3.0-5.0	> 6.0	---	---	---	---	---
		May	3.0-5.0	> 6.0	---	---	---	---	---
		June	3.0-5.0	> 6.0	---	---	---	---	---
		July	4.0-6.0	> 6.0	---	---	---	---	---
		August	4.0-6.0	> 6.0	---	---	---	---	---
		September	4.0-6.0	> 6.0	---	---	---	---	---
		October	4.0-6.0	> 6.0	---	---	---	---	---
		November	4.0-6.0	> 6.0	---	---	---	---	---
		December	4.0-6.0	> 6.0	---	---	---	---	---

Table 22.—Water Features--(continued)

(Dashes (--) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2202:(con't)									
Barnes	B								
		April	4.0-6.0	> 6.0	---	---	---	---	---
		May	4.0-6.0	> 6.0	---	---	---	---	---
		June	4.0-6.0	> 6.0	---	---	---	---	---
2203:									
Swenoda	B								
		All months	---	---	---	---	---	---	---
Barnes	B								
		All months	---	---	---	---	---	---	---
2204:									
Walsh	C								
		All months	---	---	---	---	---	---	---
2205:									
Zell	B								
		All months	---	---	---	---	---	---	---
Eckman	B								
		All months	---	---	---	---	---	---	---

1 A perched and apparent water table coexist during these months.

Table 23.—Soil Features

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
61:							
Arveson	---	---	---	---	High	High	Low
118:							
Barnes	---	---	---	---	Moderate	Moderate	Low
Buse	---	---	---	---	Moderate	Moderate	Low
120:							
Barnes	---	---	---	---	Moderate	Moderate	Low
Buse	---	---	---	---	Moderate	Moderate	Low
156:							
Barnes	---	---	---	---	Moderate	Moderate	Low
Svea	---	---	---	---	Moderate	High	Low
167:							
Bearden	---	---	---	---	High	High	Low
296:							
Brantford	---	---	---	---	Low	Low	Low
314:							
Buse	---	---	---	---	Moderate	Moderate	Low
Barnes	---	---	---	---	Moderate	Moderate	Low
319:							
Buse	---	---	---	---	Moderate	Moderate	Low
Barnes	---	---	---	---	Moderate	Moderate	Low
391:							
Cavour	---	---	---	---	Moderate	High	Moderate
Cresbard	---	---	---	---	Moderate	High	Moderate
450:							
Colvin	---	---	---	---	High	High	Low
511:							
Divide	---	---	---	---	Moderate	High	Low
536:							
Eckman	---	---	---	---	High	Moderate	Low
Zell	---	---	---	---	High	Low	Low
539:							
Edgeley	20-40	Bedrock (paralithic)	---	Soft	Moderate	High	Low
541:							
Edgeley	20-40	Bedrock (paralithic)	---	Soft	Moderate	High	Low

Table 23.—Soil Features--(continued)

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
569:							
Embden	---	---	---	---	Moderate	Moderate	Low
579:							
Embden	---	---	---	---	Moderate	Moderate	Low
Egeland	---	---	---	---	Moderate	Low	Low
595:							
Emrick	---	---	---	---	Moderate	High	Low
Cathay	---	---	---	---	Moderate	High	Moderate
597:							
Emrick	---	---	---	---	Moderate	High	Low
Heimdal	---	---	---	---	Moderate	High	Low
605:							
Esmond	---	---	---	---	Moderate	High	Low
Heimdal	---	---	---	---	Moderate	High	Low
753:							
Fram	---	---	---	---	High	High	Low
Wyard	---	---	---	---	High	High	Low
769:							
Gardena	---	---	---	---	High	Moderate	Low
773:							
Gardena	---	---	---	---	High	Moderate	Low
Eckman	---	---	---	---	High	Moderate	Low
881:							
Hamerly	---	---	---	---	High	High	Low
Tonka	---	---	---	---	High	High	Low
884:							
Hamerly	---	---	---	---	High	High	Low
Wyard	---	---	---	---	High	High	Low
893:							
Harriet	---	---	---	---	High	High	Moderate
988:							
Heimdal	---	---	---	---	Moderate	High	Low
Emrick	---	---	---	---	Moderate	High	Low
998:							
Heimdal	---	---	---	---	Moderate	High	Low
Esmond	---	---	---	---	Moderate	High	Low

Table 23.—Soil Features--(continued)

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
1001:							
Heimdal	---	---	---	---	Moderate	High	Low
Esmond	---	---	---	---	Moderate	High	Low
1015:							
Kensal	---	---	---	---	High	High	Low
1062:							
LaDelle	---	---	---	---	High	High	Low
1108:							
Larson	---	---	---	---	Moderate	High	Moderate
Cathay	---	---	---	---	Moderate	High	Moderate
1188:							
Ludden	---	---	---	---	High	High	Low
1189:							
Ludden, saline	---	---	---	---	High	High	Moderate
1221:							
Maddock	---	---	---	---	Low	Low	Low
Hecla	---	---	---	---	Moderate	Low	Low
1267:							
Marysland	---	---	---	---	High	High	Low
1268:							
Marysland, wet	---	---	---	---	High	High	Low
1427:							
Parnell	---	---	---	---	High	High	Low
1454:							
Wyndmere	---	---	---	---	High	High	Low
1466:							
Pits, sand and gravel	---	---	---	---	None	Low	Low
1710:							
Southam	---	---	---	---	High	High	Low
1762:							
Svea	---	---	---	---	Moderate	High	Low
Barnes	---	---	---	---	Moderate	Moderate	Low
1765:							
Svea	---	---	---	---	Moderate	High	Low
Buse	---	---	---	---	Moderate	Moderate	Low

Table 23.—Soil Features--(continued)

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
1766:							
Svea	---	---	---	---	Moderate	High	Low
Buse	---	---	---	---	Moderate	Moderate	Low
1769:							
Svea	---	---	---	---	Moderate	High	Low
Cresbard	---	---	---	---	Moderate	High	Moderate
1781:							
Swenoda	---	---	---	---	Moderate	High	Low
1843:							
Towner	---	---	---	---	Moderate	High	Low
1883:							
Vallers	---	---	---	---	High	High	Low
Parnell	---	---	---	---	High	High	Low
1886:							
Hamerly, saline	---	---	---	---	High	High	Moderate
Vallers, saline	---	---	---	---	High	High	Moderate
1970:							
Walum	---	---	---	---	Low	High	Low
1978:							
Water	---	---	---	---	---	---	---
2118:							
Fram	---	---	---	---	High	High	Low
Tonka	---	---	---	---	High	High	Low
2121:							
Ferney	---	---	---	---	Moderate	High	Moderate
2151:							
Binford	---	---	---	---	Low	Low	Low
Coe	---	---	---	---	Low	Low	Low
2152:							
Coe	---	---	---	---	Low	Low	Low
Binford	---	---	---	---	Low	Low	Low
2153:							
Edgeley	20-40	Bedrock (paralithic)	---	Soft	Moderate	High	Low
Kloten	9-20	Bedrock (paralithic)	---	Soft	Moderate	High	Low
Esmond	---	---	---	---	Moderate	High	Low

Table 23.—Soil Features--(continued)

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
2156:							
Lamoure	---	---	---	---	High	High	Moderate
Rauville	---	---	---	---	High	High	Moderate
2157:							
Maddock	---	---	---	---	Low	Low	Low
Esmond	---	---	---	---	Moderate	High	Low
Embden	---	---	---	---	Moderate	High	Low
2158:							
Velva	---	---	---	---	Moderate	High	Low
2159:							
Walsh	---	---	---	---	Moderate	High	Low
2196:							
Bearden, saline	---	---	---	---	High	High	Moderate
Colvin, saline	---	---	---	---	High	High	Moderate
2197:							
Edgeley	20-40	Bedrock (paralithic)	---	Soft	Moderate	High	Low
Kloten	9-20	Bedrock (paralithic)	---	Soft	Moderate	High	Low
2198:							
Hamar	---	---	---	---	Moderate	High	Low
Hecla	---	---	---	---	Moderate	Low	Low
2199:							
Hamerly	---	---	---	---	High	High	Low
Barnes	---	---	---	---	Moderate	High	Low
Tonka	---	---	---	---	High	High	Low
2200:							
Letcher	---	---	---	---	Moderate	High	Moderate
Swenoda	---	---	---	---	Moderate	High	Low
2201:							
Stirum	---	---	---	---	Moderate	High	Moderate
Arveson, saline	---	---	---	---	High	High	Low
2202:							
Swenoda	---	---	---	---	Moderate	High	Low
Barnes	---	---	---	---	Moderate	High	Low

Table 23.—Soil Features--(continued)

(Dashes(--) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictions				Potential frost action	Risk of corrosion	
	Depth	Kind	Thickness	Hardness		Uncoated steel	Concrete
	In		In				
2203:							
Swenoda	---	---	---	---	Moderate	High	Low
Barnes	---	---	---	---	Moderate	High	Low
2204:							
Walsh	---	---	---	---	Moderate	High	Low
2205:							
Zell	---	---	---	---	High	Low	Low
Eckman	---	---	---	---	High	Moderate	Low

Table 24.—Hydric Soils List

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
61: Arveson fine sandy loam							
	Arveson	Yes	Flat	2B3	Yes	No	No
	Tiffany	Yes	Depression	2B3,3	Yes	No	Yes
	Arveson, saline	Yes	Flat	2B3	Yes	No	No
	Wyndmere	No					
	Hamar	Yes	Flat	2B3	Yes	No	No
	Manfred	Yes	Flat		Yes	No	No
	Rosewood	Yes	Depression	2B3,3	Yes	No	Yes
118: Barnes-Buse loams, 3 to 6 percent slopes							
	Barnes	No					
	Buse	No					
	Svea	No					
	Hamerly	No					
	Langhei	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Vallers	Yes	Flat	2B3	Yes	No	No
120: Barnes-Buse loams, 6 to 9 percent slopes							
	Barnes	No					
	Buse	No					
	Svea	No					
	Brantford	No					
	Langhei	No					
	Hamerly	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
156: Barnes-Svea loams, 3 to 6 percent slopes							
	Barnes	No					
	Svea	No					
	Buse	No					
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
167: Bearden silt loam							
	Bearden	No					
	Perella	Yes	Depression	2B3,3	Yes	No	Yes
	Overly	No					
	Bearden, saline	No					
	Colvin	Yes	Lake plain	2B3	Yes	No	No
	Wyndmere	No					
	Enloe	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
296: Brantford loam, 0 to 3 percent slopes							
	Brandtford	No					
	Vang	No					
	Binford	No					
	Coe	No					
	Divide	No					
	Kensal	No					
	Renshaw	No					
314: Buse-Barnes loams, 9 to 15 percent slopes							
	Buse	No					
	Barnes	No					
	Svea	No					
	Hamerly	No					
	Coe	No					
	Lamoure	Yes	Depression	2B3	Yes	No	No
	Maddock	No					
319: Buse-Barnes loams, 15 to 35 percent slopes							
	Buse	No					
	Barnes	No					
	Svea	No					
	Langhei	No					
	Lamoure	Yes	Drainageway	2B3	Yes	No	No
	Vang	No					
	Coe	No					
	Maddock	No					
391: Cavour-Cresbard loams, 0 to 3 percent slopes							
	Cavour	No					
	Cresbard	No					
	Svea	No					
	Ferney	No					
	Hamerly, saline	No					
	Hamerly	No					
	Edgeley	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
450: Colvin silt loam							
	Colvin	Yes	Lake plain	2B3	Yes	No	No
	Perella	Yes	Depression	2B3,3	Yes	No	Yes
	Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	Marysland	Yes	Flat	2B3	Yes	No	No
	Bearden	No					
	Fram	No					
	Wyndmere	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
511: Divide loam, 0 to 3 percent slopes							
	Divide	No					
	Wyrene	No					
	Marysland	Yes	Flat	2B3	Yes	No	No
	Hamerly	No					
	Wyard	No					
	Fram	No					
	*Hamar, pd	Yes	Depression	2B3	Yes	No	No
536: Eckman-Zell silt loams, 6 to 9 percent slopes							
	Eckman	No					
	Zell	No					
	Gardena	No					
	Overly	No					
	Coe	No					
	Bearden	No					
	Colvin	Yes	Flat	2B3	Yes	No	No
	Maddock	No					
539: Edgeley loam, 0 to 3 percent slopes							
	Edgeley	No					
	Walsh	No					
	Barnes	No					
	Cresbard	No					
	Hamerly, saline	No					
	Kloten	No					
	Svea	No					
541: Edgeley loam, 3 to 6 percent slopes							
	Edgeley	No					
	Kloten	No					
	Brantford	No					
	Svea	No					
	Walsh	No					
	Cresbard	No					
	Vang	No					
569: Embden fine sandy loam							
	Embden	No					
	Embden, gravel substratum	No					
	Maddock	No					
	Egeland	No					
	Tiffany	Yes	Depression	2B3,3	Yes	No	Yes
	Perella	Yes	Depression	2B3,3	Yes	No	Yes
	Wyndmere	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
579: Embden-Egeland fine sandy loams, 1 to 6 percent slopes							
	Embden	No					
	Egeland	No					
	Divide	No					
	Binford	No					
	Zell	No					
	Glyndon	No					
	Tiffany	Yes	Depression	2B3,3	Yes	No	Yes
	Wyndmere	No					
595: Emrick-Cathay loams, 0 to 3 percent slopes							
	Emrick	No					
	Cathay	No					
	Heimdal	No					
	Larson	No					
	Towner	No					
	Esmond	No					
	Fram	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
597: Emrick-Heimdal loams, 0 to 3 percent slopes							
	Emrick	No					
	Heimdal	No					
	Fram	No					
	Esmond	No					
	Lanona	No					
	Tiffany	Yes	Depression	2B3,3	Yes	No	Yes
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
605: Esmond-Heimdal loams, 9 to 15 percent slopes							
	Esmond	No					
	Heimdal	No					
	Emrick	No					
	Binford	No					
	Coe	No					
	Maddock	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
753: Fram-Wyard loams, 0 to 3 percent slopes							
	Fram	No					
	Wyard	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Divide	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
753: (continued) Fram-Wyard loams, 0 to 3 percent slopes							
	Emrick	No					
	Heimdal	No					
	Vallers	Yes	Flat	2B3	Yes	No	No
	Wyndmere, saline	No					
769: Gardena silt loam, 0 to 3 percent slopes							
	Gardena	No					
	Overly	No					
	Eckman	No					
	Glyndon	No					
	Bearden	No					
	Lindaas	Yes	Depression	2B3,3	Yes	No	Yes
	Zell	No					
773: Gardena-Eckman silt loams, 3 to 6 percent slopes							
	Gardena	No					
	Eckman	No					
	Great Bend	No					
	Overly	No					
	Bearden	No					
	Zell	No					
	Colvin	Yes	Flat	2B3	Yes	No	No
	Lankin	No					
881: Hamerly-Tonka complex, 0 to 3 percent slopes							
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
	Vallers	Yes	Flat	2B3	Yes	No	No
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Cresbard	No					
	Hamerly, saline	No					
	Svea	No					
884: Hamerly-Wyard loams, 0 to 3 percent slopes							
	Hamerly	No					
	Wyard	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Vallers	Yes	Flat	2B3	Yes	No	No
	Divide	No					
	Barnes	No					
	Fram	No					
	Hamerly, saline	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
893: Harriet silt loam							
	Harriet	Yes	Drainageway	2B3	Yes	No	No
	Manfred	Yes	Depression	2B3,3	Yes	No	Yes
	Colvin, saline	Yes	Flat	2B3	Yes	No	No
	Stirum	Yes	Depression	2B3,3	Yes	No	Yes
	Ojata	Yes	Drainageway	2B3	Yes	No	No
	*Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	Bearden	No					
988: Heimdal-Emrick loams, 3 to 6 percent slopes							
	Heimdal	No					
	Emrick	No					
	Esmond	No					
	Coe	No					
	Fram	No					
	Binford	No					
	Cathay	No					
	Wyard	No					
998: Heimdal-Esmond loams, 6 to 9 percent slopes							
	Heimdal	No					
	Esmond	No					
	Emrick	No					
	Maddock	No					
	Binford	No					
	Coe	No					
	Fram	No					
	Vallers	Yes	Flat	2B3	Yes	No	No
1001: Heimdal-Esmond loams, 15 to 35 percent slopes							
	Esmond	No					
	Heimdal	No					
	Emrick	No					
	Sioux	No					
	Maddock	No					
	Binford	No					
	Coe	No					
	Dickey	No					
1015: Kensal loam							
	Kensal	No					
	Walum	No					
	Overly	No					
	Binford	No					
	Gardena	No					
	Coe	No					
	Divide	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
1062: LaDelle silty clay loam, 0 to 3 percent slopes							
	LaDelle	No					
	Wahpeton	No					
	LaPrairie	No					
	Ludden	Yes	Flood plain	2B3	Yes	No	No
	Rauville	Yes	Oxbow	2B3,3	Yes	No	Yes
	Velva	No					
	Lamoure	Yes	Flood plain	2B3	Yes	No	No
1108: Larson-Cathay loams, 0 to 3 percent slopes							
	Larson	No					
	Cathay	No					
	Fram	No					
	Emrick	No					
	Ferney	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Fram, saline	No					
	Esmond	No					
1188: Ludden silty clay							
	Ludden	Yes	Flood plain	2B3	Yes	No	No
	Ludden, saline	Yes	Flood plain	2B3	Yes	No	No
	LaDelle	No					
	Rauville	Yes	Flood plain	2B3,3	Yes	No	Yes
	Lamoure	Yes	Flood plain	2B3	Yes	No	No
1189: Ludden silty clay, saline							
	Ludden, saline	Yes	Flood plain	2B3	Yes	No	No
	Ludden, nonsaline	Yes	Flood plain	2B3	Yes	No	No
	Ryan	Yes	Drainageway	2B3	Yes	No	No
	LaDelle	No					
	Lamoure	Yes	Flood plain	2B3	Yes	No	No
	Rauville	Yes	Oxbow	2B3,3	Yes	No	Yes
1221: Maddock-Hecla loamy fine sands, 1 to 6 percent slopes							
	Maddock	No					
	Hecla	No					
	Serden	No					
	Maddock	No					
	Towner	No					
	Coe	No					
	Dickey	No					
	Esmond	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
1267: Marysland loam							
	Marysland	Yes	Flat	2B3	Yes	No	No
	Marysland, saline	Yes	Depression	2B3,3	Yes	No	No
	Colvin	Yes	Flat	2B3	Yes	No	No
	Divide	No					
	Wyrene	No					
1268: Marysland loam, wet							
	Marysland	Yes	Depression	2B3,3	Yes	No	Yes
	*Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	*Marysland, pd	Yes	Flat	2B3	Yes	No	No
	Lamoure	Yes	Flood plain	2B3	Yes	No	No
	Southam	Yes	Depression	3,2B3	Yes	No	Yes
	Divide	No					
	Tiffany	Yes	Depression	3,2B3	Yes	No	Yes
1427: Parnell silty clay loam							
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Vallers	Yes	Flat	2B3	Yes	No	No
	Grano	Yes	Depression	2B3,3	Yes	No	Yes
	*Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Southam	Yes	Depression	2B3,3	Yes	No	Yes
1454: Wyndmere fine sandy loam, loamy substratum, 0 to 3 percent slopes							
	Wyndmere	No					
	Wyrene	No					
	Divide	No					
	*Tiffany, spd	No					
	Embden	No					
	*Hamar, pd	Yes	Depression	2B3	Yes	No	No
	Arveson	Yes	Flat	2B3	Yes	No	No
1466: Pits, sand and gravel							
	Pits, gravel and sand	No					
	Sioux	No					
	Arvilla	No					
	Water	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
1710: Southam silty clay loam							
	Southam	Yes	Depression	2B3,3	Yes	No	Yes
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Vallers	Yes	Flat	2B3	Yes	No	No
	*Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	Water	Yes	Depression	2B3,3	Yes	No	Yes
	Colvin, saline	Yes	Flat	2B3	Yes	No	No
1762: Svea-Barnes loams, 0 to 3 percent slopes							
	Svea	No					
	Barnes	No					
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
	Cresbard	No					
	Vang	No					
1765: Svea-Buse loams, 3 to 6 percent slopes							
	Svea	No					
	Buse	No					
	Barnes	No					
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Brantford	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Swenoda	No					
1766: Svea-Buse loams, 6 to 9 percent slopes	Svea	No					
	Buse	No					
	Barnes	No					
	Hamerly	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Brantford	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Towner	No					
1769: Svea-Cresbard loams, 0 to 3 percent slopes							
	Svea	No					
	Cresbard	No					
	Barnes	No					
	Cavour	No					
	Hamerly	No					
	Buse	No					
	Ferney	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
1781: Swenoda fine sandy loam, 0 to 3 percent slopes							
	Swenoda	No					
	Lanona	No					
	Svea	No					
	Towner	No					
	Fram	No					
	Tiffany	Yes	Depression	2B3	Yes	No	No
	Buse	No					
1843: Towner loamy fine sand, 0 to 6 percent slopes							
	Towner	No					
	Maddock	No					
	Swenona	No					
	Tiffany	No					
	Barnes	No					
	*Hamar, pd	Yes	Depression	2B3	Yes	No	No
	Grimstad	No					
1883: Vallers-Parnell complex							
	Vallers	Yes	Flat	2B3	Yes	No	No
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Hamerly	No					
	Vallers,saline	Yes	Flat	2B3	Yes	No	No
	Marysland	Yes	Flat	2B3	Yes	No	No
	Southam	Yes	Depression	2B3,3	Yes	No	Yes
	Perella	Yes	Depression	2B3,3	Yes	No	Yes
	Tonka	Yes	Depression	3,2B3	Yes	No	Yes
1886: Hamerly and Vallers loams, saline, 0 to 3 percent slopes							
	Hamerly	No					
	Vallers	Yes	Flat	2B3	Yes	No	No
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Parnell	Yes	Depression	3,2B3	Yes	No	Yes
	Wyard	No					
	Cavour	No					
	Ferney	No					
1970: Walum sandy loam							
	Walum	No					
	Wyrene	No					
	Embden	No					
	Coe	No					
	Divide	No					
	Fram	No					
	Vallers	Yes	Flat	2B3	Yes	No	No

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
1978: Water							
	Water	Yes	Depression	2B3,3	Yes	No	Yes
	*Colvin, pd	Yes	Depression	2B3	Yes	No	No
	Southam	Yes	Depression	2B3,3	Yes	No	Yes
2118: Fram-Tonka complex, 0 to 3 percent slopes							
	Fram	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
	Heimdal	No					
	Vallers	Yes	Flat	2B3	Yes	No	No
	Glyndon	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Wyndmere	No					
2121: Ferney loam, 0 to 3 percent slopes							
	Ferney	No					
	Hamerly, saline	No					
	Cavour	No					
	Manfred	Yes	Depression	2B3,3	Yes	No	Yes
	Wyard	No					
	Cresbard	No					
	Marysland, saline	Yes	Flat	2B3	Yes	No	No
2151: Binford-Coe sandy loams, 0 to 6 percent slopes							
	Binford	No					
	Coe	No					
	Brantford	No					
	Vang	No					
	Divide	No					
	Kensal	No					
	Marysland	Yes	Flat	2B3	Yes	No	No
	Walum	No					
2152: Coe-Binford complex, 6 to 25 percent slopes							
	Coe	No					
	Binford	No					
	Vang	No					
	Heimdal	No					
	Esmond	No					
	Brantford	No					
	Divide	No					
	Fram	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria			
				Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
2153: Edgeley-Kloten-Esmond complex, 9 to 35 percent slopes							
	Edgeley	No					
	Kloten	No					
	Esmond	No					
	Walsh	No					
	Coe	No					
	Egeland	No					
	Lamoure, channeled	Yes	Drainageway	2B3,4	Yes	Yes	No
	Mekinock	No					
	Nutley	No					
2156: Lamoure and Rauville silt loams							
	Lamoure	Yes	Flood plain	2B3,4	Yes	Yes	No
	Rauville	Yes	Oxbow	2B3,3,4	Yes	Yes	Yes
	Marysland	Yes	Flood plain	2B3,4	Yes	Yes	No
	Velva	No					
	Divide	No					
	Fairdale	No					
	Harriet	Yes	Flood plain	2B3,4	Yes	Yes	No
	Vallers	Yes	Drainageway	2B3,4	Yes	Yes	No
2157: Maddock-Esmond-Embden complex, 6 to 15 percent slopes							
	Maddock	No					
	Esmond	No					
	Embden	No					
	Serden	No					
	Heimdal	No					
	Hecla	No					
	Binford	No					
	Coe	No					
	Ulen	No					
2158: Velva fine sandy loam, 0 to 6 percent slopes							
	Velva	No					
	Banks	No					
	Rauville	Yes	Oxbow	2B3,3	Yes	No	Yes
	Lamoure	Yes	Flood plain	2B3	Yes	No	No
	LaDelle	No					
	Tiffany	Yes	Depression	2B3,3	Yes	No	Yes
	Water	Yes	Channel	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
2159: Walsh silty clay loam, 1 to 6 percent slopes							
	Walsh	No					
	Barnes	No					
	Sinai	No					
	Nutley	No					
	Binford	No					
	Edgeley	No					
	Kensal	No					
2196: Bearden and Colvin silt loams, saline							
	Bearden	No					
	Colvin	Yes	Lake plain	2B3	Yes	No	No
	Bearden, nonsaline	No					
	Colvin, nonsaline	Yes	Flat	2B3	Yes	No	No
	Exline	No					
	Harriet	Yes	Drainageway	2B3	Yes	No	No
	*Colvin, vpd	Yes	Depression	2B3,3	Yes	No	Yes
	Perella	Yes	Depression	2B3,3	Yes	No	Yes
2197: Edgeley-Kloten complex, 6 to 9 percent slopes							
	Edgeley	No					
	Kloten	No					
	Heimdal	No					
	Nutley	No					
	Walsh	No					
	Cavour	No					
	Emrick	No					
	Darnen	No					
2198: Hamar-Hecla loamy fine sands							
	Hamar	No					
	Hecla	No					
	Ulen	No					
	Arveson	Yes	Depression	2B3	Yes	No	No
	Towner	No					
	Wyndmere	No					
	Fossum	Yes	Depression	2B3,3	Yes	No	Yes
	Letcher	No					
2199: Hamerly-Barnes-Tonka complex, 0 to 6 percent slopes, very stony							
	Hamerly	No					
	Barnes	No					

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria: Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
2199:(continued) Hamerly-Barnes-Tonka complex, 0 to 6 percent slopes, very stony							
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes
	Vallers	Yes	Flat	2B3	Yes	No	No
	Emrick	No					
	Parnell	Yes	Depression	2B3,3	Yes	No	Yes
	Cresbard	No					
	Hamerly, saline	No					
	Cavour	No					
2200: Letcher-Swenoda fine sandy loams, 0 to 3 percent slopes							
	Letcher	No					
	Swenoda	No					
	Lanona	No					
	Cathay	No					
	Lemert	No					
	Stirum	Yes	Flat	2B3	Yes	No	No
	Wyndmere	No					
	Towner	No					
2201: Stirum-Arveson, saline, fine sandy loams							
	Stirum	Yes	Lake plain	2B3	Yes	No	No
	Arveson	Yes	Lake plain	2B3	Yes	No	No
	Marysland, saline	Yes	Lake plain	2B3	Yes	No	No
	*Vallers	Yes	Flat	2B3	Yes	No	No
	Manfred	Yes	Depression	2B3,3	Yes	No	Yes
	Gilby, saline	No					
	Letcher	No					
	Marysland	Yes	Lake plain	2B3	Yes	No	No
2202: Swenoda-Barnes fine sandy loams, 3 to 6 percent slopes							
	Swenoda	No					
	Barnes	No					
	Gardena	No					
	Buse	No					
	Binford	No					
	Towner	No					
	Maddock	No					
	Tonka	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--(continued)

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the Conventional and Special Symbols Legend.

Map Symbol Map Unit Name	Component	Hydric	Local Landform	Hydric Soils Criteria			
				Hydric Criteria	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria
2203: Swenoda-Barnes fine sandy loams, 6 to 9 percent slopes							
	Swenoda	No					
	Barnes	No					
	Buse	No					
	Maddock	No					
	Binford	No					
	Coe	No					
	Towner	No					
	Vallers	Yes	Drainageway	2B3	Yes	No	No
2204: Walsh silty clay loam, 6 to 9 percent slopes							
	Walsh	No					
	Sinai	No					
	Barnes	No					
	Nutley	No					
	Edgeley	No					
	Wahpeton	No					
	Vang	No					
2205: Zell-Eckman silt loams, 9 to 25 percent slopes							
	Zell	No					
	Eckman	No					
	Gardena	No					
	Emrick	No					
	Maddock	No					
	Great Bend	No					
	Coe	No					
	Esmond	No					

* swp=somewhat poorly drained; pd=poorly drained; vpd=very poorly drained

HYDRIC SOILS CRITERIA CODES AND DEFINITIONS

1. All Histosols, except Folists, or

2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
   a. somewhat poorly drained with a water table equal to 0.0 foot from the surface during the growing season, or
   b. poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 feet from the surface during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches or for other soils
      (2) water table at less than or equal to 0.5 feet from the surface during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 inches, or
      (3) water table at less than or equal to 1.0 foot from the surface during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 inches, or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or

4. Soils that are frequently flooded for long duration or very long duration during the growing season.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha, alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal-unit month (AUM). The amount of forage required by one mature cow weighing approximately 1,000 pounds, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Atterberg Limits. A general term that encompasses liquid limit, plastic limit, and shrinkage limit. It is used as an integral part of several engineering classification systems.

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:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Badland. Moderately steep to 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.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface. It may be either **lithic** (digging with a hand spade impractical) or **paralithic** (dug with difficulty with a spade).

Blowout. A shallow depression from which all or most of the soil material has been removed by the 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.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion.

$CaCO_3$ Equivalent. The quantity of carbonate (CO_3) in the soil expressed as $CaCO_3$. This material is important to the fertility, erosion, available water holding capacity, and genesis of a soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

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 plant community. 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 textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Collapsed lake plan. A previously nearly level surface marking the floor of an extinct lake, filled in by well-sorted deposits from inflowing streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Collapsed outwash plain. A previously broad, flat or gently sloping alluvial sheet of outwash deposited by meltwater streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas 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 or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

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.

Contrasting soils (Dissimilar soils). Soils that do not share limits of diagnostic criteria, behave and perform in a similar manner, or have similar conservation needs or management requirements for the major land uses in the survey area.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

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.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized:

Excessively drained . .... these soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained .... these soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained .... these soils have an intermediate water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained ... these soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless a drainage system is installed. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.. .... these soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless a drainage system is installed. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained .. .. these soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained .... these soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except rice) unless a drainage system is installed.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. An area of ground at a lower elevation than the surrounding ground and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may or may not have distinctly incised channels at its upper reaches or throughout its course.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Drift. A general term applied to all material transported by a glacier and deposited directly from the ice or by running water coming from the ice. Drift includes unstratified material (till) that forms moraines, and stratified glaciofluvial deposits that form outwash plains, eskers, kames, varves, and glaciolacustrine sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

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.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of 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 human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flooding. The temporary covering of the soil surface by flowing water from any source.

Flooding frequency classes:

None .... 0 percent chance of flooding in any year.

Rare......0 to 5 percent chance of flooding in any year.

Occasional .... 5 to 50 percent chance of flooding in any year.

Frequent.....more than 50 percent chance of flooding in any year.

Flooding duration classes:

Extremely brief .... 0.1 to 4.0 hours
Very brief .... 4 to 48 hours
Brief .... 2 to 7 days
Long .... 7 to 30 days
Very long .... more than 30 days

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Footslope. The bottom of a slope or the lower part of any elevated landform.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. A gullied map unit is one that has numerous gullies.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

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. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon......an organic layer of fresh and decaying plant residue.

A horizon......the mineral horizon at or near the surface in which an accumulation of humidified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

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 A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 soil material. 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......Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hummock. A slight mound or rise of ground above a level surface; generally of equidimensional shape and not ridge-like.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydric soil. Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions for the upper part.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin .... Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border. .... Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding .... Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation .... Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle). ....Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow ....Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler ..... Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation ...... Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding .... Water, released at high points, is allowed to flow onto an area without controlled distribution.

K Factor. Soil erodibility factor in the Universal Soil Loss Equation.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Ksat. See saturated hydraulic conductivity.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A surface marking the floor of an extinct lake, filled in by well sorted, stratified sediments.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Lime. A soil material that consists of precipitated calcium or magnesium carbonate.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

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, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. 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).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. A blocky or massive, fine-grained sedimentary rock that consists of a mixture of clay, silt, and sand particles, the proportion of which vary from place to place.

Munsell notation. A designation of color by degrees of three simple variables - hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial meltwater.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, hardpan, fragipan, claypan, plowpan, and traffic pan.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. See saturated hydraulic conductivity (Ksat).

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Very brief	less than 2 days
Brief	2 to 7 days
Long	7 to 30 days
Very long	more than 30 days

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Porcelanite (scoria). Shale and clay that are fused as a result of their proximity to a burning coal vein.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

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.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

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.

Rangeland. Land on which the potential natural vegetation is predominantly grass, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, and areas that support certain forb and shrub communities.

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 degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma (2 or less) zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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.

Retrogression. The process by which rangeland vegetation changes significantly from the natural potential plant community. syn., range deterioration, site deterioration.

Revised Universal Soil Loss Equation (RUSLE). An erosion model designed to predict the long term average soil loss carried by runoff from specific field slopes in specified cropping and management systems.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. Exposures of bare bedrock other than lava flows and rock-lined pits. Most rock outcrops are hard rock.

Root shearing. The cutting, tearing, and disruption of plant roots by the hooves of animals during grazing when the soil is wet and soft.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline seep. Areas of nonirrigated soils with restricted drainage, where salinity has recently developed.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline-sodic soil. A soil containing a combination of soluble salts and exchangeable sodium sufficient to interfere with the growth of plants.

Salty water (in tables). Water that is too salty for consumption by livestock.

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-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Saturated hydraulic conductivity (Ksat). The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. Terms describing saturated hydraulic conductivity, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 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

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). 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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Level	0 to 1 percent
Level and nearly level	0 to 3 percent
Nearly level	1 to 3 percent
Gently sloping or undulating	3 to 6 percent
Moderately sloping or gently rolling	6 to 9 percent
Strongly sloping or rolling	9 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 35 percent
Very steep	More than 35 percent

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.

Sodic (alkali) 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.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil depth class. The distance from the top of the soil to the underlying bedrock. The distance, in inches, is expressed as:

Very shallow	less than 10 inches
Shallow	10 to 20 inches
Moderately deep	20 to 40 inches
Deep	40 to 60 inches
Very deep	greater than 60 inches

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion 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 grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

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. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are - sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The lower gentle slope of a hillside. The lowest part of a footslope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Universal Soil Loss Equation (USLE). An equation used to design water erosion control systems: **A—RKLSPC** where **A** is average annual soil loss in tons per acre per year; **R** is the rainfall factor; **K** is the soil erodibility factor; **L** is the length of slope; **S** is the percent slope; **P** is the conservation practice factor; and **C** is the cropping and management factor.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very deep soil. A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant rows.

Very shallow soil. A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Water table. The upper surface of ground water or that level below the surface where the soil is saturated with water. For soil survey purposes, the depth the water table is observed is within 60 inches from the surface.

Apparent .... Level at which water stands in a freshly dug, unlined borehole after it has adequate time for adjustments in the surrounding soil.

Perched .... A saturated soil zone above an unsaturated layer in the soil.

Artesian .... A water table under hydrostatic head beneath an impermeable layer.

Seasonal .... A water table within 60 inches of the surface during the growing season.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windsculptured. A land surface of which its form has been changed by action of the wind.

Accessibility Statement