



United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Renville County, Minnesota

Part II



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How To Use This Soil Survey

This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the general soil map units, detailed soil map units, and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

On the **general soil map**, which is the color map preceding the detailed soil maps, the survey area is divided into groups of associated soils called general soil map units. This map is useful in planning the 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, then refer to the section **General Soil Map Units** in Part I of this survey for a general description of the soils in your area.

The **detailed soil maps** follow the general soil map. 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 symbols that are in that area. Turn to the **Index to Map Units** in Part I of this survey, which lists the map units by symbol and name and shows the page where each map unit is described.

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The 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 November 1993. Soil names and descriptions were approved in April 1995. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service and the Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Renville County Soil and Water Conservation District. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Renville County. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources.

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

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Cover: An area of nearly level cropland in the Canisteo-Okoboji-Nicollet association.

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Detailed Soil Map Unit Legend

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86—Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes
94C—Terril loam, 6 to 12 percent slopes
102B—Clarion loam, moderately fine substratum, 2 to 5 percent slopes
112—Harps clay loam, 0 to 2 percent slopes
113—Webster clay loam, 0 to 2 percent slopes
118—Crippin loam, moderately fine substratum, 1 to 3 percent slopes
128C2—Grogan silt loam, 6 to 15 percent slopes, eroded
130—Nicollet clay loam, 1 to 3 percent slopes
134—Okoboji silty clay loam, depressional, 0 to 1 percent slopes
156—Fairhaven silt loam, 0 to 2 percent slopes
211—Lura silty clay, depressional, 0 to 1 percent slopes
227—Lemond loam, 0 to 2 percent slopes
247—Linder loam, 0 to 2 percent slopes
255—Mayer loam, 0 to 2 percent slopes
282—Hanska loam, 0 to 2 percent slopes
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539—Klossner muck, depressional, 0 to 1 percent slopes
574—Du Page loam, 0 to 2 percent slopes, occasionally flooded
575—Nishna silty clay, 0 to 2 percent slopes, occasionally flooded
595F—Swanlake loam, 18 to 50 percent slopes
610—Calco silty clay loam, 0 to 1 percent slopes, frequently flooded
770C2—Ves-Terril complex, 6 to 15 percent slopes, eroded
810—Coriff-Fieldon complex, 0 to 2 percent slopes
817—Canisteo-Seaforth complex, 0 to 3 percent slopes
875C—Hawick-Estherville complex, 6 to 12 percent slopes
887B—Clarion-Swanlake complex, 2 to 6 percent slopes
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960F—Storden-Omsrud complex, 18 to 50 percent slopes
978—Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes
999C2—Ves-Storden-Hawick complex, 6 to 12 percent slopes, eroded

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Soil Survey of Renville County, Minnesota

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

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

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

Interpretive ratings help engineers, planners, and others understand how soil properties influence important nonagricultural uses, such as building site development and construction materials. The ratings indicate the most restrictive soil features affecting the suitability of the soils for these uses.

Soils are rated in their natural state. No unusual

modification of the soil site or material is made other than that which is considered normal practice for the rated use. Even though soils may have limitations, it is important to remember that engineers and others can modify soil features or can design or adjust the plans for a structure to compensate for most of the limitations. Most of these practices, however, are costly. The final decision in selecting a site for a particular use generally involves weighing the costs of site preparation and maintenance.

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

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

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

The classification and extent of the soils in this survey area are shown in the tables "Classification of the Soils" and "Acreage and Proportionate Extent of the Soils," which are at the end of this section.

CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Amiret-----	Calcic Hapludolls, fine-loamy, mixed, mesic
Arkton-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Bechyn-----	Lithic Hapludolls, loamy, mixed, mesic
Biscay-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Blue Earth-----	Mollic Fluvaquents, fine-silty, mixed (calcareous), mesic
Calco-----	Cumulic Haplaquolls, fine-silty, mixed (calcareous), mesic
Calcousta-----	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Canisteco-----	Typic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Cedarrock-----	Cumulic Epiaquolls, fine-loamy, mixed (calcareous), mesic
Chetomba-----	Typic Endoaquolls, fine-silty, mixed, mesic
Clarion-----	Typic Hapludolls, fine-loamy, mixed, mesic
Coland-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Cordova-----	Typic Argiaquolls, fine-loamy, mixed, mesic
Coriff-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Corvuso-----	Typic Calciaquolls, fine, mesic
Cosmos-----	Vertic Epiaquolls, fine, montmorillonitic, mesic
Crippin-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Crooksford-----	Calcic Hapludolls, fine-silty, mixed, mesic
Danube-----	Typic Calciaquolls, coarse-silty over sandy or sandy-skeletal, mesic
Delft-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Dickinson-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Dickman-----	Typic Hapludolls, sandy, mixed, mesic
Du Page-----	Cumulic Hapludolls, fine-loamy, mixed, mesic
Estherville-----	Typic Hapludolls, sandy, mixed, mesic
Fairhaven-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Fieldon-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Glencoe-----	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Grogan-----	Typic Hapludolls, coarse-silty, mixed, mesic
Hanlon-----	Cumulic Hapludolls, coarse-loamy, mixed, mesic
Hanska-----	Typic Endoaquolls, coarse-loamy, mixed, mesic
Harps-----	Typic Calciaquolls, fine-loamy, mesic
Havelock-----	Cumulic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Hawick-----	Entic Hapludolls, sandy, mixed, mesic
Kandiyohi-----	Aquertic Hapludolls, fine, montmorillonitic, mesic
Klossner-----	Terric Medisaprists, loamy, mixed, euic, mesic
Leen-----	Typic Calciaquolls, fine-silty, mixed, mesic
Lemond-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Linder-----	Aquic Hapludolls, coarse-loamy, mixed, mesic
Louris-----	Aquic Calciudolls, fine-silty, mixed, mesic
Lowlein-----	Typic Hapludolls, coarse-loamy, mixed, mesic
Lura-----	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Mayer-----	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic
Minneiska-----	Mollic Udifluvents, coarse-loamy, mixed (calcareous), mesic
Muskego-----	Limnic Medisaprists, coprogenous, euic, mesic
Nicollet-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Nishna-----	Vertic Endoaquolls, fine, montmorillonitic (calcareous), mesic
Normania-----	Aquic Hapludolls, fine-loamy, mixed, mesic
Okoboji-----	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Omsrud-----	Typic Hapludolls, fine-loamy, mixed, mesic
Prinsburg-----	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Rolfe-----	Typic Argialbolls, fine, montmorillonitic, mesic
Rushriver-----	Mollic Fluvaquents, coarse-loamy, mixed (calcareous), mesic
Seaforth-----	Aquic Calciudolls, fine-loamy, mixed, mesic
Storden-----	Typic Eutrochrepts, fine-loamy, mixed, mesic
Strout-----	Vertic Hapludolls, fine, montmorillonitic, mesic
Swanlake-----	Typic Calciudolls, fine-loamy, mixed, mesic
Terril-----	Cumulic Hapludolls, fine-loamy, mixed, mesic
Udipsamments-----	Udipsamments
Ves-----	Calcic Hapludolls, fine-loamy, mixed, mesic
Wadena-----	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Webster-----	Typic Endoaquolls, fine-loamy, mixed, mesic

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
27A	Dickinson loam, 0 to 2 percent slopes-----	1,057	0.2
27B	Dickinson loam, 2 to 6 percent slopes-----	1,025	0.2
35	Blue Earth mucky silt loam, 0 to 1 percent slopes-----	2,221	0.4
39A	Wadena loam, 0 to 2 percent slopes-----	890	0.1
39B	Wadena loam, 2 to 6 percent slopes-----	474	*
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded-----	4,440	0.7
86	Canisteco clay loam, moderately fine substratum, 0 to 2 percent slopes-----	13,143	2.1
94C	Terril loam, 6 to 12 percent slopes-----	267	*
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes-----	14,498	2.3
112	Harps clay loam, 0 to 2 percent slopes-----	30,051	4.8
113	Webster clay loam, 0 to 2 percent slopes-----	37,100	5.9
118	Crippin loam, moderately fine substratum, 1 to 3 percent slopes-----	7,957	1.3
128C2	Grogan silt loam, 6 to 15 percent slopes, eroded-----	90	*
130	Nicollet clay loam, 1 to 3 percent slopes-----	48,493	7.7
134	Okoboji silty clay loam, depressionnal, 0 to 1 percent slopes-----	29,376	4.6
156	Fairhaven silt loam, 0 to 2 percent slopes-----	646	0.1
211	Lura silty clay, depressionnal, 0 to 1 percent slopes-----	1,425	0.2
227	Lemond loam, 0 to 2 percent slopes-----	388	*
247	Linder loam, 0 to 2 percent slopes-----	1,601	0.3
255	Mayer loam, 0 to 2 percent slopes-----	3,861	0.6
282	Hanska loam, 0 to 2 percent slopes-----	326	*
318	Mayer clay loam, depressionnal, 0 to 1 percent slopes-----	387	*
327A	Dickman sandy loam, 0 to 2 percent slopes-----	1,048	0.2
327B	Dickman sandy loam, 2 to 6 percent slopes-----	1,312	0.2
327C	Dickman sandy loam, 6 to 12 percent slopes-----	221	*
336	Delft loam, 1 to 3 percent slopes-----	1,146	0.2
386	Okoboji mucky silty clay loam, depressionnal, 0 to 1 percent slopes-----	10,916	1.7
392	Biscay loam, 0 to 2 percent slopes-----	1,171	0.2
423	Seaforth loam, 1 to 3 percent slopes-----	16,538	2.6
446	Normania loam, 1 to 3 percent slopes-----	15,486	2.4
463A	Minneiska loam, 0 to 2 percent slopes, occasionally flooded-----	1,892	0.3
463B	Minneiska loam, 1 to 4 percent slopes, rarely flooded-----	711	0.1
519	Klossner muck, depressionnal, calcareous, 0 to 1 percent slopes-----	474	*
525	Muskego muck, depressionnal, 0 to 1 percent slopes-----	258	*
539	Klossner muck, depressionnal, 0 to 1 percent slopes-----	1,225	0.2
574	Du Page loam, 0 to 2 percent slopes, occasionally flooded-----	982	0.2
575	Nishna silty clay, 0 to 2 percent slopes, occasionally flooded-----	505	*
595F	Swanlake loam, 18 to 50 percent slopes-----	2,863	0.5
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded-----	420	*
770C2	Ves-Terril complex, 6 to 15 percent slopes, eroded-----	1,048	0.2
810	Coriff-Fieldon complex, 0 to 2 percent slopes-----	320	*
817	Canisteco-Seaforth complex, 0 to 3 percent slopes-----	1,988	0.3
875C	Hawick-Estherville complex, 6 to 12 percent slopes-----	365	*
887B	Clarion-Swanlake complex, 2 to 6 percent slopes-----	37,100	5.9
899	Harps-Okoboji, depressionnal, complex, 0 to 2 percent slopes-----	16,785	2.7
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes-----	5,000	0.8
927	Harps-Seaforth-Okoboji, depressionnal, complex, 0 to 3 percent slopes-----	9,019	1.4
954C2	Ves-Storden complex, 6 to 12 percent slopes, eroded-----	6,326	1.0
956	Canisteco-Glencoe, depressionnal, complex, 0 to 2 percent slopes-----	88,984	14.1
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded-----	364	*
960F	Storden-Omsrud complex, 18 to 50 percent slopes-----	220	*
978	Cordova-Rolfe, depressionnal, complex, 0 to 2 percent slopes-----	1,776	0.3
999C2	Ves-Storden-Hawick complex, 6 to 12 percent slopes, eroded-----	1,091	0.2
1030	Pits, gravel-Udipsamments complex-----	1,017	0.2
1080	Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes-----	1,724	0.3
1100	Nicollet silty clay loam, 1 to 3 percent slopes-----	1,997	0.3
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes-----	1,749	0.3
1159B	Strout-Arkton complex, 2 to 6 percent slopes-----	1,368	0.2
1162A	Kandiyohi clay, 0 to 2 percent slopes-----	3,414	0.5
1169	Corvuso-Lura, depressionnal, complex, 0 to 2 percent slopes-----	15,178	2.4
1193	Cosmos silty clay, 0 to 2 percent slopes-----	5,121	0.8

See footnote at end of table.

ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
1205	Leen-Okoboji, depressional, complex, 0 to 2 percent slopes-----	19,511	3.1
1242F	Swanlake-Terril complex, 18 to 50 percent slopes-----	5,068	0.8
1261B	Bechyn loam, 2 to 6 percent slopes-----	301	*
1262	Seaforth silt loam, 1 to 3 percent slopes-----	2,952	0.5
1267	Cedarrock silty clay loam, 0 to 2 percent slopes, frequently flooded-----	488	*
1268	Hanlon loam, 1 to 3 percent slopes, rarely flooded-----	649	0.1
1269	Lowlein silt loam, 0 to 2 percent slopes-----	191	*
1270D	Bechyn-Rock outcrop complex, 0 to 40 percent slopes-----	2,022	0.3
1285	Chetomba silty clay loam, 0 to 2 percent slopes-----	5,566	0.9
1286	Prinsburg silty clay loam, 0 to 2 percent slopes-----	9,522	1.5
1287	Calco silty clay loam, ponded, 0 to 1 percent slopes, frequently flooded-----	395	*
1355B	Amiret-Swanlake complex, 2 to 6 percent slopes-----	34,100	5.4
1356	Water, miscellaneous-----	295	*
1369A	Crooksford silt loam, 1 to 3 percent slopes-----	12,423	2.0
1369B	Crooksford silt loam, 3 to 5 percent slopes-----	3,151	0.5
1370B	Amiret loam, 2 to 5 percent slopes-----	4,574	0.7
1371B	Crooksford-Swanlake complex, 3 to 6 percent slopes-----	6,193	1.0
1373C	Omsrud-Storden-Hawick complex, 6 to 12 percent slopes, eroded-----	2,319	0.4
1374	Havelock clay loam, 0 to 2 percent slopes, occasionally flooded-----	5,970	0.9
1375D	Storden-Ves complex, 12 to 18 percent slopes, eroded-----	700	0.1
1376C	Omsrud-Storden complex, 6 to 12 percent slopes, eroded-----	4,556	0.7
1382	Louris silt loam, 1 to 3 percent slopes-----	3,632	0.6
1386B	Amiret-Swanlake-Hawick complex, 2 to 6 percent slopes-----	1,595	0.3
1388B	Terril loam, moderately wet, 2 to 6 percent slopes-----	1,802	0.3
1389	Havelock silt loam, 0 to 2 percent slopes, frequently flooded-----	1,556	0.2
1390	Leen silty clay loam, 0 to 2 percent slopes-----	12,058	1.9
1392B	Grogan silt loam, moderately wet, 1 to 4 percent slopes-----	365	*
1802	Calcousta-Okoboji complex, depressional, 0 to 1 percent slopes-----	2,972	0.5
1833	Coland clay loam, 0 to 2 percent slopes, occasionally flooded-----	1,439	0.2
1834	Coland clay loam, 0 to 2 percent slopes, frequently flooded-----	330	*
1845A	Estherville loam, 0 to 2 percent slopes-----	1,219	0.2
1845B	Estherville loam, 2 to 6 percent slopes-----	2,360	0.4
1900	Okoboji-Canistee complex, depressional, 0 to 1 percent slopes-----	15,917	2.5
1917	Nishna silty clay loam, 0 to 1 percent slopes, frequently flooded-----	436	*
1958	Danube silty clay, 0 to 2 percent slopes-----	3,092	0.5
1999	Minneiska-Rushriver complex, 0 to 2 percent slopes, frequently flooded-----	1,343	0.2
	Water-----	2,200	0.3
	Total-----	632,100	100.0

* Less than 0.1 percent.

Agronomy

General management needed for crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Natural Resources Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Crops and Pasture

In 1991, approximately 566,000 acres in the county was used as cropland. Major crops include corn; soybeans; small grain, such as wheat and oats; and sugar beets. Of the total acreage used as cropland, 234,400 acres was used for soybeans; 214,500 acres for corn; 31,900 acres for sugar beets; 30,500 acres for sweet corn and peas; 18,500 acres for wheat and oats; 12,100 acres for dry edible beans; and 10,800 acres for hay (Minnesota Crop and Livestock Reporting Service, 1990). The remaining 13,300 acres was used for various other crops. Over the past 10 years, the acreage used for row crops has increased by about 20 percent. Most of this additional acreage was formerly used for the production of small grain.

The hazard of water erosion is an important management concern on many of the soils suitable for cropland in Renville County. The rate at which any soil erodes depends on many factors, including the gradient and length of slopes, soil texture, type and amount of vegetative cover, and climate. Over time, soil moves from high landscape positions to lower ones. As a result, soils on shoulders and back slopes, such as Clarion and Ves soils, generally have a thinner surface layer than soils on foot slopes and toe slopes, such as Delft and Terril soils. Erosion is greatly accelerated if the protective vegetative cover is removed and if poor management practices are applied, such as using clean tillage methods and operating machinery up and down the slopes.

The rapid loss of topsoil is damaging for three reasons. First, productivity is lost when nutrients and organic matter are removed. Replacing these elements is costly but is necessary to maintain yields. Second, the loss of organic matter and the incorporation of subsoil material into the tillage zone results in poor tilth, reduces the rate of water infiltration, and reduces the exchange of air within the soil. Third, water erosion on farmland causes sedimentation of rivers and streams. Controlling erosion minimizes this pollution and improves the quality of water for recreational uses and for fish and wildlife.

Water erosion is a major problem on the sloping soils, such as Storden, Swanlake, Ves, and Clarion soils. Measures that reduce the runoff rate and increase the rate of water infiltration are needed to control water erosion. Examples are terraces, stripcropping, contour farming, grassed waterways, water- and sediment-control basins, conservation tillage, and crop residue management (fig. 1). Including legumes and grasses in the cropping sequence also reduces the hazard of erosion and increases the amount of nitrogen in the soil for the following crop. Not all practices are equally suited to all soil types, and a combination of practices commonly is needed.

Wind erosion occurs throughout the county but is most severe on coarse textured soils, such as Dickman and Esterville soils, and on soils that have a surface layer of muck, such as the Klossner and Muskego soils that have been drained and cultivated. Conservation tillage, crop residue management, field windbreaks, and winter cover crops help to control wind erosion.

Soil wetness is a major limitation on a large percentage of the soils in the county. Many soils are naturally so wet that the production of the commonly grown crops is not possible unless an artificial drainage system is installed. An extensive system of surface ditches that includes county, judicial, and private ditches has improved drainage (fig. 2). Removing excess water improves root development and allows the soil to warm up earlier in the spring.

Improved drainage is beneficial on poorly drained and very poorly drained soils, such as Canisteo,



Figure 1.—A young soybean crop in an area of Clarion loam, moderately fine substratum, 2 to 5 percent slopes. The residue from the previous corn crop helps to control water erosion.

Glencoe, Okoboji, and Webster soils (fig. 3). Any drainage work should comply with Minnesota State Wetland Conservation Act laws and with Federal Farm Security Act and Food and Commodities Trade Act guidelines.

Droughtiness is a limitation in some areas, including areas of Dickman, Estherville, and Hawick soils.

Conservation tillage, no-till planting, stripcropping, timely tillage, and a cropping system that includes grasses and legumes reduce the rates of evaporation and runoff and increase the available water capacity. Also, crops that have a relatively deep root zone, require lower amounts of water, or mature early may be selected. Alfalfa and wheat are examples.

Seasonal flooding is a hazard on some soils, such as Calco, Minneiska, and Nishna soils.

Soil fertility is naturally high in most of the soils in the county. Crops on most of the soils respond well to applications of fertilizer. The kinds and amounts of fertilizer needed depend on the kind of soil, past and present management, and the kind of crop. The soils in Renville County have a naturally low content of phosphorus but generally have adequate amounts of potassium and lime. Applications of fertilizer should be based on the results of soil tests.

Excess free carbonates are in the surface layer of some soils, such as Harps, Louris, Seaforth, and Leen

soils. High soil pH and a high content of carbonates inhibit a plant's ability to take up iron. The resulting condition is known as iron chlorosis. The accumulation of carbonates is greatest on the rims of depressions. These poorly drained rims act as "wicks" by drawing water upward from the subsoil, which contains dissolved carbonates. The carbonates are deposited on the soil surface when the water evaporates. They are visible as a whitish or grayish cast on the soil surface (fig. 4). Careful selection of crops and crop varieties, a good fertility program, and an adequate drainage system are needed on these soils.

Tilth is an important factor affecting the preparation



Figure 2.—Numerous open ditches provide drainage in many areas of Renville County.



Figure 3.—Ponded water after a heavy rain in an area of Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes. Yields may be reduced if the water cannot be removed adequately.

of a desirable seedbed. Soils that have good structure and tilth are granular and porous. Returning crop residue to the surface and applying manure and other organic material improve soil structure. Cultivating moderately fine textured and fine textured soils when they are wet damages soil structure, results in cloddiness, and makes seedbed preparation difficult. Some soils, such as Kandiyohi and Cosmos soils, have a high content of clay and are easily compacted. Tilling only at the proper moisture content helps to prevent the formation of clods and minimizes compaction. These soils are commonly tilled in the fall because freezing

and thawing cycles help to break up the clods. Fall plowing, however, does not leave an adequate crop residue on the surface and thus does not protect the soils from wind erosion and water erosion.

A small amount of the acreage in Renville County is used as permanent pasture. Soils commonly used as pasture include Storden, Swanlake, Cedarrock, Calco, and Havelock soils. Most areas that are used as pasture are too steep, too wet, or too shallow over bedrock for cultivation, have large stones at or near the surface, or are frequently flooded (fig. 5). High stocking rates and overgrazing result in poor pasture production

and increase the rates of runoff and erosion. Timely deferment of grazing, reduced stocking rates, and pasture rotation are good pasture management measures. Reseeding can improve pasture species. It may be necessary in areas where stands are weak or where more productive species are desired. Reintroducing warm-season grasses, such as big bluestem, little bluestem, switchgrass, and sideoats grama, cool-season grasses, such as Kentucky bluegrass, reed canarygrass, and smooth bromegrass, and legumes, such as birdsfoot trefoil and alfalfa, can help to provide full-season grazing.

Good pasture management includes controlling weeds and applying fertilizers. The applications of fertilizer should be based on the results of soil tests. The Natural Resources Conservation Service, the Soil and Water Conservation District, or the Cooperative Extension Service can provide assistance with species and variety selection, establishment techniques, and management guidelines.

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Management Considerations." The main concerns in managing



Figure 4.—An area of Leen-Okoboji, depressional, complex, 0 to 2 percent slopes. The calcareous Leen soil appears as the light colored rims around depressions. The dark Okoboji soil is in the depressions.



Figure 5.—An area of Havelock silt loam, 0 to 2 percent slopes, frequently flooded, used as pasture.

nonirrigated cropland are conserving moisture, controlling wind erosion and water erosion, and maintaining soil fertility.

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the rate of water infiltration. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture.

Generally, a combination of several practices is needed to control *wind erosion* and *water erosion*. Conservation tillage, stripcropping, field windbreaks, contour farming, conservation cropping systems, crop residue management, terraces, diversions, and grassed

waterways help to prevent excessive soil loss.

Measures that are effective in maintaining *soil fertility* include applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to prevent the loss of organic matter and plant nutrients and thus helps to maintain productivity, although the level of fertility can be reduced even in areas where erosion is controlled. All of the soils in the county that are used for nonirrigated crops respond well to applications of fertilizer.

Some of the considerations shown in the table cannot be easily overcome. These are *channels*,

flooding, gullies, and ponding.

Additional considerations are as follows:

Lime content, limited available water capacity, potential poor tilth and compaction, and restricted permeability.—These limitations can be minimized by incorporating green manure crops, manure, or crop residue into the soil; applying a system of conservation tillage; and using conservation cropping systems. Also, crops may respond well to additions of phosphate fertilizer to soils that have a high content of lime.

Potential for ground-water contamination.—The proper use of nutrients and pesticides can reduce the risk of ground-water contamination.

Potential for surface-water contamination.—The risk of surface-water contamination can be reduced by the proper use of nutrients and pesticides and by conservation farming practices that reduce the runoff rate.

Surface crusting.—This limitation retards seedling development after periods of heavy rainfall.

Surface rock fragments.—This limitation causes rapid wear of tillage equipment. It cannot be easily overcome.

Surface stones.—Stones or boulders on or near the surface can hinder normal tillage unless they are removed.

Salt content.—In areas where this is a limitation, only salt-tolerant crops should be grown.

On irrigated soils the main management concerns are *efficient water use, nutrient management, control of erosion, pest and weed control, and timely planting and harvesting* for a successful crop. An irrigation system that provides optimum control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. Also, it can create drainage problems, raise the water table, and increase soil salinity.

Explanation of Criteria

Acid soil.—The pH is less than 6.1.

Channeled.—The word “channeled” is included in the map unit name.

Dense layer.—The bulk density is 1.80 g/cc or greater within the soil profile.

Depth to rock.—The depth to bedrock is less than 40 inches.

Eroded.—The word “eroded” is included in the map unit name.

Excessive permeability.—Permeability is 6 inches per hour or more within the soil profile.

Flooding.—Flooding is occasional or frequent.

Gullied.—The word “gullied” is included in the map unit name.

High organic matter content.—The surface layer has more than 20 percent organic matter.

Lime content.—The pH is 7.4 or more in the surface layer, or the wind erodibility group is 4L.

Limited available water capacity.—The available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 6 inches or less.

Limited organic matter content.—The content of organic matter is 2 percent or less in the surface layer.

Ponding.—Ponding duration is assigned to the map unit component. The water table is above the surface.

Potential poor tilth and compaction.—The content of clay is 27 percent or more in the surface layer.

Potential for ground-water contamination (by nutrients or pesticides).—Depth to the water table is 4 feet or less, the permeability of any layer is more than 6.0 inches per hour, or the depth to bedrock is less than 60 inches.

Potential for surface-water contamination (by nutrients or pesticides).—The map unit component 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.

Restricted permeability.—Permeability is less than 0.06 inch per hour within the soil profile.

Salt content.—The electrical conductivity is 4 or more in the surface layer or 8 or more within a depth of 30 inches.

Slope (equipment limitation).—The slope is more than 15 percent.

Surface crusting.—The content of clay is 27 percent or more and the content of organic matter is 2 percent or less in the surface layer.

Surface rock fragments (equipment limitation).—The terms describing the texture of the surface layer include any rock fragment modifier, except for gravelly, channery, stony, very stony, extremely stony, bouldery, very bouldery, and extremely bouldery.

Surface stones (equipment limitation).—The word “stony” or “bouldery” is included in the map unit name or in the description of the surface layer.

Water erosion.—Either the slope is 6 percent or more, or the slope is more than 3 percent and less than 6 percent and the surface layer is not sandy.

Water table.—A water table is within 2.5 feet of the surface.

Wind erosion.—The wind erodibility group is 1, 2, 3, or 4L.

Crop Yield Estimates

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the table "Land Capability and Yields per Acre of Crops and Pasture." In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

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

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

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

Crops other than those shown in 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 of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Pasture and Hayland Interpretations

Under good management, proper grazing is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing helps plants to maintain sufficient and generally vigorous top growth during the growing season. Brush control is essential in many areas, and weed control generally is needed. Rotation grazing and renovation also are important management practices.

Yield estimates are often provided in animal unit months (AUM), or the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

The local office of the Natural Resources

Conservation Service or of the Cooperative Extension Service can provide information about forage yields other than those shown in the table "Land Capability and Yields per Acre of Crops and Pasture."

Land Capability Classification

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

In the capability system, soils generally are grouped at three levels—capability class, subclass, and unit (USDA, 1961). These categories indicate the degree and kinds of limitations affecting mechanized farming systems that produce the more commonly grown field crops, such as corn, small grain, cotton, hay, and field-grown vegetables. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use.

If properly managed, soils in classes 1, 2, 3, and 4 are suitable for the mechanized production of commonly grown field crops and for pasture and woodland. The degree of the soil limitations affecting the production of cultivated crops increases progressively from class 1 to class 4. The limitations can affect levels of production and the risk of permanent soil deterioration caused by erosion and other factors.

Soils in classes 5, 6, and 7 are generally not suited to the mechanized production of commonly grown field crops without special management, but they are suitable for plants that provide a permanent cover, such as grasses and trees. The severity of the soil limitations affecting crops increases progressively from class 5 to class 7.

Areas in class 8 are generally not suitable for crops, pasture, or woodland without a level of management that is impractical. These areas may have potential for other uses, such as recreational facilities and wildlife habitat.

Capability subclasses identify the dominant kind of

limitation in the class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2*e*. The letter *e* shows that 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 the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class 1 because the 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.

The capability classification of each map unit is given in the table "Land Capability and Yields per Acre of Crops and Pasture" at the end of this section.

Prime Farmland

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, State, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. An adequate moisture supply and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They either are used for food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming

in National forests, National parks, military reservations, and State parks.

Prime farmland soils commonly receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable, and the level of acidity or alkalinity and the content of salts and sodium are acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods, and they are not frequently flooded during the growing season or are protected from flooding. Slopes range mainly from 0 to 6 percent.

Soils that have a high water table or are subject to flooding may qualify as prime farmland where these limitations are overcome by drainage measures or flood control. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information about the criteria for prime farmland can be obtained at the local office of the Natural Resources Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 576,976 acres, or nearly 91.6 percent of the survey area, meets the requirements for prime farmland.

The map units in the survey area that meet the requirements for prime farmland are listed in the table "Prime Farmland." This list does not constitute a recommendation for a particular land use. On some soils included in the table, measures that overcome limitations are needed. The need for these measures is indicated in parentheses after the map unit name. 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 "Soil Series and Detailed Soil Map Units" in Part I of this survey.

Erosion Factors

Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices. The erosion factors for the soils in the survey area are listed in the table "Physical Properties of the Soils."

Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the 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 plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

Fragment-Free Soil Erodibility (Kf) Factor

This is one of the factors used in the revised Universal Soil Loss Equation. It shows the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss 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 gulying, and the value of nutrients lost through erosion.

Wind Erodibility Groups

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index (I) factor is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEG) having similar percentages of dry soil aggregates larger than 0.84 millimeter. The wind erodibility groups and wind erodibility index numbers are listed in the table "Physical Properties of the Soils."

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Woodland, Windbreaks, and Environmental Plantings

Paul Flynn, forester, Natural Resources Conservation Service, and Thomas Kalahar and Donald Bidinger, Renville County Soil and Water Conservation District, helped prepare this section.

Renville County has approximately 8,000 acres of native woodland. Most of this woodland is on flood plains associated with the Minnesota River and on the

steep slope breaks and draws adjacent to the river. The woodland on the Minnesota River flood plain is primarily on Bechyn, Cedarrock, Havelock, and Minneiska soils. The woodland on the steep slope breaks and draws adjacent to the river is primarily on Delft, Swanlake, and Terril soils. The forest type on the flood plains consists primarily of American elm, silver maple, green ash, and cottonwood. Less common species include basswood and boxelder. The forest type on the slope breaks and draws consists primarily of bur oak, red oak, and redcedar and lesser amounts of boxelder, cottonwood, and woody shrubs, such as wild plum, sumac, prickly ash, and common chokecherry.

Early settlers used the trees for fuel, lumber, and fenceposts. There is currently some renewed interest in the use of trees for fuel (firewood). The principal use of trees, however, is for protection and esthetic purposes. Trees protect the soil, homes, domestic livestock, wildlife, and watersheds. Windbreaks have been planted in Renville County since the early days of settlement. Since the 1970's, more than 1,000,000 trees have been planted on about 2,500 acres by county farmers and landowners with the assistance of the Renville County Soil and Water Conservation District and the Natural Resources Conservation Service. Trees and shrubs are still needed around numerous farmsteads, and many other farmstead plantings are in need of renovation.

Before trees are planted, the factors that should be considered include (1) the purpose of the planting, (2) the suitability of the soils, (3) the adaptability of the various species of trees and shrubs, (4) the location and design of the windbreak, and (5) the selection of a source of hardy and adapted trees and shrubs. If these factors are not considered, a poor or unsuccessful planting may result. The establishment of a windbreak or an environmental planting and the growth of the trees and shrubs also depend on suitable site preparation and adequate maintenance after the trees and shrubs are planted. Grasses and weeds should be eliminated before the planting is made, and regrowth of competing vegetation should be controlled throughout the life of the planting. Some replanting of the trees and shrubs may be necessary during the first 2 years.

The table "Woodland Management and Productivity" can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an

indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: *R*, *X*, *W*, *T*, *D*, *C*, *S*, *F*, and *N*.

In this table, *slight*, *moderate*, and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions.

The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to

be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

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. 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.

The table "Windbreaks and Environmental Plantings" shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in this table are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a nursery.

Windbreak Suitability Groups

Windbreak suitability groups consist of soils in which the kinds and degrees of the hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are about the same. The windbreak suitability group for each soil in the survey area is listed in the table "Windbreak Suitability Groups" at the end of this section. The following paragraphs explain the characteristics of the soils in each group.

Group 1 consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and do not have free carbonates in the upper 20 inches.

Group 1K consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and have free carbonates within 20 inches of the surface. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

Group 2 consists of poorly drained soils that have been artificially drained and do not have free carbonates in the upper 20 inches. Permeability varies.

Group 2K consists of poorly drained or very poorly drained soils that have been artificially drained and have free carbonates within 20 inches of the surface. Permeability varies. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

Group 2H consists of very poorly drained soils that have been artificially drained and have more than 16 inches of organic material. Permeability varies.

Group 2W consists of very poorly drained soils that are subject to ponding and have been artificially drained. It includes soils that have an organic surface layer up to 16 inches thick. Permeability varies.

Group 3 consists of soils that are well drained or moderately well drained and are loamy or silty throughout. Permeability is moderate or moderately slow. These soils do not have free carbonates in the upper 20 inches.

Group 4 consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a silty or loamy surface layer and a clayey subsoil. Permeability is slow or very slow.

Group 4C consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a clayey surface layer and subsoil. Permeability is slow or very slow.

Group 4F consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a substratum of dense till. Permeability is slow or very slow.

Group 5 consists of soils that are excessively drained

to moderately well drained and have a moderate available water capacity. These soils are dominantly fine sandy loam or sandy loam, but some are sandy in the upper part and loamy in the lower part.

Group 6G consists of excessively drained to moderately well drained soils that are loamy in the upper part and have sand or sand and gravel at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

Group 6D consists of excessively drained to moderately well drained, loamy soils that have bedrock at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

Group 7 consists of excessively drained to well

drained soils that are dominantly loamy fine sand or coarser textured and are shallow to sand or to sand and gravel. These soils have a low available water capacity.

Group 8 consists of excessively drained to well drained, loamy soils that have free carbonates within 20 inches of the surface.

Group 9W consists of soils that are somewhat poorly drained, poorly drained, or very poorly drained and are moderately saline (the electrical conductivity is 8 to 16).

Group 10 consists of soils or miscellaneous land types that generally are not suitable for windbreaks. One or more characteristics, such as soil depth, texture, wetness, available water capacity, or slope, limit the planting, survival, or growth of trees and shrubs.

CROPLAND MANAGEMENT CONSIDERATIONS

(See text for a description of the considerations listed in this table)

Map symbol and soil name	Cropland management considerations
7A: Dickinson-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination
27B: Dickinson-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion
35: Blue Earth-----	High organic matter content Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
39A: Wadena-----	Excessive permeability Potential for ground-water contamination
39B: Wadena-----	Excessive permeability Potential for ground-water contamination Potential for surface-water contamination Water erosion
85: Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
86: Canisteo-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
94C: Terril-----	Potential for surface-water contamination Water erosion
102B: Clarion-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
112: Harps-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
113: Webster-----	Potential for ground-water contamination Water table
118: Crippin-----	Lime content Potential for ground-water contamination Water table Wind erosion
128C2: Grogan-----	Potential for surface-water contamination Previously eroded Water erosion
130: Nicollet-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
134: Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
156: Fairhaven-----	Excessive permeability Potential for ground-water contamination
211: Lura-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
227: Lemond-----	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
247: Linder-----	Excessive permeability Potential for ground-water contamination Water table
255: Mayer-----	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
282: Hanska-----	Excessive permeability Potential for ground-water contamination Water table
318: Mayer-----	Excessive permeability Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
327A: Dickman-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
327B: Dickman-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion Wind erosion
327C: Dickman-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
336: Delft-----	Potential for ground-water contamination Water table
386: Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
392: Biscay-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table
423: Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
446: Normania-----	Potential for ground-water contamination Water table

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
463A: Minneiska-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Wind erosion
463B: Minneiska-----	Lime content Potential for ground-water contamination Water erosion Wind erosion
519: Klossner-----	High organic matter content Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
525: Muskego-----	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
539: Klossner-----	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
574: Du Page-----	Flooding Potential for surface-water contamination
575: Nishna-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
595F: Swanlake-----	Lime content Potential for surface-water contamination Slope Water erosion Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
610: Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
770C2: Ves-----	Potential for surface-water contamination Previously eroded Water erosion
Terril-----	Potential for surface-water contamination Previously eroded Water erosion
810: Coriff-----	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
Fieldon-----	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion
817: Canisteo-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
875C: Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion
Estherville-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
887B: Clarion-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
887B: Swanlake-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
899: Harps-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
920B: Clarion-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Water erosion Wind erosion
Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion
927: Harps-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
954C2: Ves-----	Potential for surface-water contamination Previously eroded Water erosion
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
956:	
Canisteo-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Glencoe-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
960D2:	
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Omsrud-----	Potential for surface-water contamination Previously eroded Slope Water erosion
960F:	
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Slope Water erosion Wind erosion
Omsrud-----	Potential for surface-water contamination Slope Water erosion
978:	
Cordova-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
Rolfe-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
999C2:	
Ves-----	Potential for surface-water contamination Previously eroded Water erosion
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
999C2: Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
1030: Pits. Udipsamments-----	Nonsoil material
1080: Klossner-----	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
Glencoe-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1100: Nicollet-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
1101: Webster-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
1159B: Strout-----	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion
Arkton-----	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion
1162A: Kandiyohi-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
1169: Corvuso-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1169: Lura-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1193: Cosmos-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
1205: Leen-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1242F: Swanlake-----	Lime content Potential for surface-water contamination Slope Water erosion Wind erosion
Terril-----	Potential for surface-water contamination Slope Water erosion
1261B: Bechyn-----	Depth to rock Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion
1262: Seaforth-----	Lime content Potential for ground-water contamination Wind erosion
1267: Cedarrock-----	Depth to rock Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Restricted permeability Water table Wind erosion
1268: Hanlon-----	Limited organic matter content Potential for ground-water contamination

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1269: Lowleyn-----	Potential for ground-water contamination
1270D: Bechyn-----	Depth to rock Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Slope Water erosion
Rock outcrop-----	Limited available water capacity Potential for ground-water contamination Restricted permeability Slope Water erosion
1285: Chetomba-----	Potential for ground-water contamination Potential poor tilth and compaction Water table
1286: Prinsburg-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
1287: Calco-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
1355B: Amiret-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
Swanlake-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
1356. Water	
1369A: Crooksford-----	Potential for ground-water contamination Water table
1369B: Crooksford-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion Water table

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1370B: Amiret-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
1371B: Crooksford-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion Water table
Swanlake-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
1373C: Omsrud-----	Potential for surface-water contamination Previously eroded Water erosion
Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
1374: Havelock-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
1375D: Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Ves-----	Potential for surface-water contamination Previously eroded Slope Water erosion
1376C: Omsrud-----	Potential for surface-water contamination Previously eroded Water erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1376C: Storden-----	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
1382: Louris-----	Lime content Potential for ground-water contamination Water table Wind erosion
1386B: Amiret-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
Swanlake-----	Lime content Potential for surface-water contamination Water erosion Wind erosion
Hawick-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion Wind erosion
1388B: Terril-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
1389: Havelock-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1390: Leen-----	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
1392B: Grogan-----	Potential for ground-water contamination Water erosion
1802: Calcousta-----	Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1802: Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1833, 1834: Coland-----	Flooding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1845A: Estherville-----	Excessive permeability Limited available water capacity Potential for ground-water contamination
1845B: Estherville-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion
1900: Okoboji-----	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Canisteo-----	Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
1917: Nishna-----	Flooding Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1958: Danube-----	Excessive permeability Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table
1999: Minneiska-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Wind erosion

CROPLAND MANAGEMENT CONSIDERATIONS--Continued

Map symbol and soil name	Cropland management considerations
1999: Rushriver-----	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Brome-grass- alfalfa	Brome-grass- alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	
27A----- Dickinson	3s	98	30	78	47	4.0	3
27B----- Dickinson	3e	95	29	76	46	3.9	3
35----- Blue Earth	3w	109	32	76	45	4.2	3
39A----- Wadena	2s	110	36	87	52	4.8	4
39B----- Wadena	2e	106	33	80	48	4.3	3
85----- Calco	2w	125	37	76	46	4.7	4
86----- Canisteo	2w	145	42	85	51	5.2	4
94C----- Terril	3e	147	45	86	52	6.0	5
102B----- Clarion	2e	149	47	90	54	6.1	5
112----- Harps	2w	132	37	78	47	4.7	4
113----- Webster	2w	148	46	88	53	5.5	4
118----- Crippin	1	152	46	90	54	10.0	4
128C2----- Grogan	3e	133	41	78	47	5.5	4
130----- Nicollet	3e	154	48	92	55	6.1	5
134----- Okoboji	3w	132	42	81	49	4.4	3
156----- Fairhaven	2s	136	42	88	53	5.6	4
211----- Lura	3w	129	40	78	47	3.2	4
227----- Lemond	2w	114	33	78	47	4.2	3
247----- Linder	2s	98	30	76	47	3.9	3

See footnote at end of table.

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass- alfalfa	Bromegrass- alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	
255----- Mayer	2w	113	33	77	47	4.2	3
282----- Hanska	2w	105	34	80	48	4.0	3
318----- Mayer	3w	109	30	72	44	3.5	3
327A----- Dickman	3s	78	26	67	40	3.1	2
327B----- Dickman	3e	74	23	65	39	3.0	2
327C----- Dickman	4e	69	21	60	35	2.6	2
336----- Delft	2w	148	46	88	53	5.5	4
386----- Okoboji	3w	133	41	79	47	4.3	3
392----- Biscay	2w	115	35	78	47	3.8	3
423----- Seaforth	2s	149	47	91	55	6.3	5
446----- Normania	1	153	47	91	55	6.3	5
463A----- Minneiska	2w	138	43	82	49	5.5	4
463B----- Minneiska	2e	150	46	89	54	6.1	5
519----- Klossner	3w	108	32	75	45	4.2	3
525----- Muskego	4w	113	34	78	47	4.3	3
539----- Klossner	3w	113	34	78	47	4.3	3
574----- Du Page	2w	138	43	82	49	5.6	4
575----- Nishna	3w	103	30	70	42	3.8	3
595F----- Swanlake	6e	---	---	---	---	---	---
610----- Calco	5w	---	---	---	---	---	---

See footnote at end of table.

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass- alfalfa	Bromegrass- alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	
770C2----- Ves-Terril	3e	138	43	81	48	5.6	4
810----- Coriff-Fieldon	2w	126	37	81	49	4.7	4
817----- Canisteco----- Seaforth-----	2w 2s	147	44	87	52	5.6	4
875C----- Hawick- Estherville	4s	48	15	47	28	2.0	2
887B----- Clarion- Swanlake	2e	148	46	90	54	6.1	5
899----- Harps----- Okoboji-----	2w 3w	130	36	76	46	4.6	4
920B----- Clarion----- Storden----- Hawick-----	2e 2e 4s	131	40	82	49	5.3	4
927----- Harps----- Seaforth----- Okoboji-----	2w 2s 3w	138	41	82	50	6.3	4
954C2----- Ves-Storden	3e	125	40	78	47	5.3	4
956----- Canisteco----- Glencoe-----	2w 3w	140	42	83	50	4.9	4
960D2----- Storden-Omsrud	4e	110	34	65	39	4.4	3
960F----- Storden-Omsrud	7e	---	---	---	---	---	---
978----- Cordova----- Rolfe-----	2w 3w	144	44	86	51	5.1	4

See footnote at end of table.

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass- alfalfa	Bromegrass- alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	
999C2----- Ves-----	3e	111	34	70	42	4.6	4
Storden-----	3e						
Hawick-----	4s						
1030: Pits.							
Udipsamments---	8s	---	---	---	---	---	---
1080----- Klossner- Okoboji-Glencoe	8w	---	---	---	---	---	---
1100----- Nicollet	1	154	48	92	55	6.1	5
1101----- Webster	2w	148	46	88	53	5.5	4
1159B----- Strout-Arkton	2e	140	41	84	51	5.3	4
1162A----- Kandiyohi	2w	144	44	88	51	---	4
1169----- Corvuso-----	2w	129	40	78	47	4.2	3
Lura-----	3w						
1193----- Cosmos	2w	144	44	85	51	5.2	4
1205----- Leen-----	2w	140	42	83	50	4.9	4
Okoboji-----	3w						
1242F----- Swanlake-----	6e	---	---	---	---	---	---
Terril-----	7e						
1261B----- Bechyn	3e	65	22	50	30	3.8	3
1262----- Seaforth	2s	150	47	92	55	6.3	5
1267----- Cedarrock	5w	---	---	---	---	---	---
1268----- Hanlon	1	151	47	86	53	6.0	5
1269----- Lowlein	1	146	45	90	54	5.9	4

See footnote at end of table.

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass- alfalfa	Bromegrass- alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	
1270D----- Bechyn-----	7s	---	---	---	---	---	---
Rock outcrop---	8s						
1285----- Chetomba	2w	146	45	88	52	5.3	4
1286----- Prinsburg	2w	142	42	85	51	5.2	4
1287----- Calco	4w	---	---	---	---	---	---
1355B----- Amiret-Swanlake	2e	145	44	90	54	6.1	5
1356. Water							
1369A----- Crooksford	1	153	47	91	55	6.3	5
1369B----- Crooksford	2e	150	46	90	54	6.1	5
1370B----- Amiret	2e	150	45	90	54	6.1	5
1371B----- Crooksford- Swanlake	2e	146	46	89	54	6.0	5
1373C----- Omsrud-----	3e	115	35	72	43	8.9	4
Storden-----	3e						
Hawick-----	4s						
1374----- Havelock	2w	128	37	76	46	4.7	4
1375D----- Storden-Ves	4e	108	33	51	31	4.0	3
1376C----- Omsrud-Storden	3e	129	40	77	46	5.2	4
1382----- Louris	1	145	43	87	52	5.6	4
1386B----- Amiret-----	2e	132	41	83	50	5.3	4
Swanlake-----	2e						
Hawick-----	4s						
1388B----- Terril	2e	153	47	92	55	6.3	5

See footnote at end of table.

LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass- alfalfa	Bromegrass- alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>AUM*</u>	
1389----- Havelock	5w	---	---	---	---	---	---
1390----- Leen	2w	142	42	85	51	5.2	4
1392B----- Grogan	1	150	46	90	52	6.0	5
1802----- Calcousta- Okoboji	3w	130	39	78	47	6.0	3
1833----- Coland	2w	133	41	79	48	4.8	4
1834----- Coland	5w	---	---	---	---	---	---
1845A----- Estherville	3s	69	23	60	37	2.9	2
1845B----- Estherville	3s	61	19	55	33	2.5	2
1900----- Okoboji-Canisteo	3w	132	40	79	47	4.3	3
1917----- Nishna	6w	---	---	---	---	---	---
1958----- Danube	2w	114	33	78	47	4.2	3
1999----- Minneiska- Rushriver	5w	---	---	---	---	---	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

PRIME FARMLAND

Map symbol	Soil name
27A	Dickinson loam, 0 to 2 percent slopes
27B	Dickinson loam, 2 to 6 percent slopes
39A	Wadena loam, 0 to 2 percent slopes
39B	Wadena loam, 2 to 6 percent slopes
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded (where drained)
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes (where drained)
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes
112	Harps clay loam, 0 to 2 percent slopes (where drained)
113	Webster clay loam, 0 to 2 percent slopes (where drained)
118	Crippin loam, moderately fine substratum, 1 to 3 percent slopes
130	Nicollet clay loam, 1 to 3 percent slopes
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes (where drained)
156	Fairhaven silt loam, 0 to 2 percent slopes
211	Lura silty clay, depressional, 0 to 1 percent slopes (where drained)
227	Lemond loam, 0 to 2 percent slopes (where drained)
247	Linder loam, 0 to 2 percent slopes
255	Mayer loam, 0 to 2 percent slopes (where drained)
282	Hanska loam, 0 to 2 percent slopes (where drained)
336	Delft loam, 1 to 3 percent slopes (where drained)
386	Okoboji mucky silty clay loam, depressional, 0 to 1 percent slopes (where drained)
392	Biscay loam, 0 to 2 percent slopes (where drained)
423	Seaforth loam, 1 to 3 percent slopes
446	Normania loam, 1 to 3 percent slopes
463A	Minneiska loam, 0 to 2 percent slopes, occasionally flooded
463B	Minneiska loam, 1 to 4 percent slopes, rarely flooded
574	Du Page loam, 0 to 2 percent slopes, occasionally flooded
575	Nishna silty clay, 0 to 2 percent slopes, occasionally flooded (where drained)
810	Coriff-Fieldon complex, 0 to 2 percent slopes (where drained)
817	Canisteo-Seaforth complex, 0 to 3 percent slopes (where drained)
887B	Clarion-Swanlake complex, 2 to 6 percent slopes
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes (where drained)
927	Harps-Seaforth-Okoboji, depressional, complex, 0 to 3 percent slopes (where drained)
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes (where drained)
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes (where drained)
1100	Nicollet silty clay loam, 1 to 3 percent slopes
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes (where drained)
1159B	Strout-Arkton complex, 2 to 6 percent slopes
1162A	Kandiyohi clay, 0 to 2 percent slopes (where drained)
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes (where drained)
1193	Cosmos silty clay, 0 to 2 percent slopes (where drained)
1205	Leen-Okoboji, depressional, complex, 0 to 2 percent slopes (where drained)
1262	Seaforth silt loam, 1 to 3 percent slopes
1268	Hanlon loam, 1 to 3 percent slopes, rarely flooded
1269	Lowlein silt loam, 0 to 2 percent slopes
1285	Chetomba silty clay loam, 0 to 2 percent slopes (where drained)
1286	Prinsburg silty clay loam, 0 to 2 percent slopes (where drained)
1355B	Amiret-Swanlake complex, 2 to 6 percent slopes
1369A	Crooksford silt loam, 1 to 3 percent slopes
1369B	Crooksford silt loam, 3 to 5 percent slopes
1370B	Amiret loam, 2 to 5 percent slopes
1371B	Crooksford-Swanlake complex, 3 to 6 percent slopes
1374	Havelock clay loam, 0 to 2 percent slopes, occasionally flooded (where drained)
1382	Louris silt loam, 1 to 3 percent slopes
1388B	Terril loam, moderately wet, 2 to 6 percent slopes
1390	Leen silty clay loam, 0 to 2 percent slopes (where drained)
1392B	Grogan silt loam, moderately wet, 1 to 4 percent slopes
1802	Calcousta-Okoboji complex, depressional, 0 to 1 percent slopes (where drained)
1833	Coland clay loam, 0 to 2 percent slopes, occasionally flooded (where drained)
1900	Okoboji-Canisteo complex, depressional, 0 to 1 percent slopes (where drained)
1958	Danube silty clay, 0 to 2 percent slopes (where drained)

WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed)

Map symbol and soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
463A, 463B: Minneiska-----	9A	Slight	Slight	Slight	Slight	Severe	Eastern cottonwood--	100	9	Silver maple, green ash, black walnut, white oak.
525: Muskego-----	3W	Slight	Severe	Severe	Severe	Severe	Tamarack-----	50	3	---
978: Cordova-----	4W	Slight	Moderate	Moderate	Slight	Severe	American basswood--- Green ash----- Sugar maple----- Eastern cottonwood--	60 52 55 90	4 3 2 7	Black ash, eastern cottonwood.
Rolfe.										
1268: Hanlon-----	3A	Slight	Slight	Slight	Slight	Moderate	White oak----- Northern red oak----	55 55	3 3	Sugar maple, black walnut, European larch, red pine, eastern white pine.
1999: Minneiska-----	9A	Slight	Slight	Slight	Slight	Severe	Eastern cottonwood--	100	9	Silver maple, green ash, black walnut, white oak.
Rushriver-----	1W	Slight	Severe	Slight	Moderate	Severe	Silver maple----- Green ash----- Eastern cottonwood-- American basswood---	60 60 90 80	1 4 7 6	Silver maple, green ash, white spruce, eastern cottonwood, American basswood.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
27A, 27B: Dickinson-----	Lilac-----	Siberian peashrub, eastern redcedar, blue spruce, chokecherry, silver buffaloberry, northern whitecedar.	Amur maple, hackberry, honeylocust, Norway spruce, Black Hills spruce, red pine, eastern white pine, bur oak.	Silver maple, green ash.	Eastern cottonwood.
35: Blue Earth-----	---	Redosier dogwood	Tall purple willow	White willow, golden willow.	Eastern cottonwood.
39A, 39B: Wadena-----	Siberian peashrub, lilac.	Hackberry, eastern redcedar, blue spruce, silver buffaloberry, northern whitecedar.	Norway spruce, Black Hills spruce, eastern white pine, chokecherry, bur oak.	Silver maple, green ash.	Eastern cottonwood.
85: Calco-----	---	Redosier dogwood, American plum, lilac, northern whitecedar.	Hackberry, eastern redcedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
86: Canisteo-----	Redosier dogwood	Cotoneaster, blue spruce, American plum, lilac, northern whitecedar.	Hackberry, eastern redcedar, Norway spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
94C: Terril-----	---	Siberian peashrub, cotoneaster, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, honeylocust, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
102B: Clarion-----	---	Siberian peashrub, cotoneaster, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
112: Harps-----	Redosier dogwood	Blue spruce, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
113: Webster-----	---	Redosier dogwood, cotoneaster, American plum.	Hackberry, white spruce, Black Hills spruce, tall purple willow, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
118: Crippin-----	---	Cotoneaster, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
128C2: Grogan-----	---	Siberian peashrub, redosier dogwood, blue spruce, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, thornless honeylocust, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
130: Nicollet-----	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, eastern redcedar, Norway spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
134: Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
156: Fairhaven-----	Siberian peashrub	Hackberry, eastern redcedar, Manchurian crabapple, lilac.	Green ash, honeylocust, jack pine, eastern white pine, bur oak.	---	---
211: Lura-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
227: Lemond-----	---	Redosier dogwood, lilac, northern whitecedar.	Hackberry, eastern redcedar white spruce.	Green ash, honeylocust, golden willow.	Silver maple, eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
247: Linder-----	---	Redosier dogwood, American plum, lilac.	Amur maple, white spruce, blue spruce, northern whitecedar.	Silver maple, hackberry, green ash, Austrian pine, eastern white pine.	---
255: Mayer-----	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
282: Hanska-----	---	Redosier dogwood, American plum.	Amur maple, hackberry, white spruce, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.
318: Mayer-----	Lilac-----	Redosier dogwood, American plum, chokecherry, silver buffaloberry, northern whitecedar.	Hackberry, eastern redcedar, ponderosa pine, blue spruce.	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
327A, 327B, 327C: Dickman-----	Siberian peashrub	Eastern redcedar, Black Hills spruce, blue spruce, American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Green ash, Norway spruce, jack pine, white spruce, Austrian pine.	Red pine, eastern white pine, Scotch pine, eastern cottonwood.	---
336: Delft-----	---	Redosier dogwood, American plum.	Hackberry, white spruce, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.
386: Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
392: Biscay-----	---	Redosier dogwood, cotoneaster, American plum.	Hackberry, white spruce, tall purple willow, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
423: Seaforth-----	---	Siberian peashrub, blue spruce, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
446: Normania-----	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, lilac.	Hackberry, eastern redcedar, Norway spruce, white spruce, ponderosa pine.	Green ash, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
463A, 463B: Minneiska-----	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
519: Klossner-----	Common ninebark---	Silky dogwood, redosier dogwood, Amur privet, whitebelle honeysuckle.	Black ash, tamarack, white spruce, tall purple willow.	Golden willow, black willow.	Imperial Carolina poplar.
525: Muskego-----	---	Silky dogwood, redosier dogwood, common ninebark, late lilac, northern whitecedar, nannyberry viburnum, American cranberrybush.	Tamarack, Manchurian crabapple, white spruce, Japanese tree lilac.	Siberian crabapple	Imperial Carolina poplar.
539: Klossner-----	Common ninebark---	Silky dogwood, Amur privet.	Tamarack, tall purple willow.	Golden willow, black willow.	Imperial Carolina poplar.
574: Du Page-----	---	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce, bur oak.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
575: Nishna-----	Lilac-----	Blue spruce-----	Hackberry, eastern redcedar, Black Hills spruce, ponderosa pine.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
595F: Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
610: Calco-----	---	Redosier dogwood, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Silver maple, eastern cottonwood.
770C2: Ves-----	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Eastern redcedar, Black Hills spruce, ponderosa pine, bur oak.	Hackberry, green ash, honeylocust, Norway spruce.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Terril-----	---	Siberian peashrub, cotoneaster, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, honeylocust, eastern redcedar, Norway spruce, Black Hills spruce, blue spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
810: Coriff-----	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Fieldon-----	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
817: Canisteco-----	---	Siberian peashrub, redosier dogwood, cotoneaster, American plum, lilac, northern whitecedar.	Hackberry, eastern redcedar, Norway spruce, blue spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Seaforth-----	---	Siberian peashrub, blue spruce, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, bur oak.	Green ash, thornless honeylocust, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
875C: Hawick-----	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, Norway spruce, Austrian pine.	Red pine, eastern white pine, Siberian elm.	---
Estherville-----	Siberian peashrub	Eastern redcedar, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, honeylocust, jack pine, white spruce, Austrian pine, red pine.	Eastern white pine, eastern cottonwood.	---

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
887B: Clarion-----	---	Siberian peashrub, American plum, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce, blue spruce.	Green ash, eastern white pine.	---
Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
899: Harps-----	Redosier dogwood	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
920B: Clarion-----	---	Siberian peashrub, American plum, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, eastern white pine.	---
Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Hawick-----	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, jack pine, Austrian pine.	Red pine, eastern white pine.	---
927: Harps-----	Redosier dogwood	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Seaforth-----	---	Siberian peashrub, blue spruce, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, bur oak.	Green ash, thornless honeylocust, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	Golden willow, black willow.	Silver maple, eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
954C2: Ves-----	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Eastern redcedar, Norway spruce, Black Hills spruce, bur oak.	Hackberry, green ash, honeylocust.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
956: Canisteo-----	Redosier dogwood	Blue spruce, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Glencoe-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
960D2: Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Omsrud-----	---	Siberian peashrub, redosier dogwood, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
960F: Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Omsrud-----	---	Siberian peashrub, redosier dogwood, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce, blue spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
978: Cordova-----	---	Redosier dogwood, American plum.	Hackberry, white spruce, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
Rolfe-----	---	Redosier dogwood, American plum.	Hackberry, white spruce, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
999C2: Ves-----	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Eastern redcedar, Norway spruce, Black Hills spruce, ponderosa pine, bur oak.	Hackberry, green ash, honeylocust, black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Storden-----	American plum-----	Siberian peashrub, hackberry, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Hawick-----	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, Norway spruce, Austrian pine.	Red pine, eastern white pine.	---
1100: Nicollet-----	---	Siberian peashrub, redosier dogwood, cotoneaster, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, Norway spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1101: Webster-----	---	Redosier dogwood, cotoneaster, American plum.	Amur maple, hackberry, white spruce, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
1159B: Strout-----	---	Siberian peashrub, redosier dogwood, cotoneaster, American plum, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Arkton-----	---	Siberian peashrub, lilac.	Hackberry, eastern redcedar, white spruce, bur oak.	Green ash, golden willow.	Honeylocust, eastern cottonwood.
1162A: Kandiyohi-----	Lilac-----	Redosier dogwood, eastern redcedar.	Hackberry, green ash, honeylocust, American plum.	---	---
1169: Corvuso-----	Redosier dogwood	Cotoneaster, American plum, silver buffaloberry.	Hackberry, eastern redcedar, northern whitecedar.	Green ash, black willow.	Eastern cottonwood, Siouxland cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1169: Lura-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
1193: Cosmos-----	---	Redosier dogwood, late lilac.	Amur maple, hackberry, white spruce, American plum, northern whitecedar.	Golden willow, black willow.	Silver maple, green ash, eastern cottonwood.
1205: Leen-----	Redosier dogwood	Eastern redcedar, blue spruce, American plum, common chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
1242F: Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Terril-----	---	Siberian peashrub, blue spruce, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, eastern white pine.	---
1262: Seaforth-----	---	Chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
1267: Cedarrock-----	---	---	Tamarack, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
1268: Hanlon-----	---	Redosier dogwood, lilac.	Amur maple, white spruce, Black Hills spruce, northern whitecedar.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1269: Lowlein-----	---	Redosier dogwood, lilac.	Amur maple, white spruce, Black Hills spruce, northern whitecedar.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.
1285: Chetomba-----	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Hackberry, white spruce, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood, basswood.
1286: Prinsburg-----	---	Redosier dogwood, blue spruce, chokecherry, silver buffaloberry, lilac.	Hackberry, eastern redcedar, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1287: Calco-----	---	Redosier dogwood, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood.
1355B: Amiret-----	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, silver buffaloberry, lilac.	Amur maple, eastern redcedar, Norway spruce, bur oak.	Hackberry, green ash, honeylocust, black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
1369A: Crooksford-----	---	Siberian peashrub, Peking cotoneaster, redosier dogwood, eastern redcedar, blue spruce, American plum, silver buffaloberry, lilac.	Norway spruce, white spruce.	Black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1369B: Crooksford-----	---	Siberian peashrub, redosier dogwood, eastern redcedar, blue spruce, American plum, silver buffaloberry, lilac.	Norway spruce, white spruce.	Black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1370B: Amiret-----	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, silver buffaloberry, lilac.	Amur maple, eastern redcedar, Norway spruce, bur oak.	Hackberry, green ash, honeylocust, black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1371B: Crooksford-----	---	Siberian peashrub, redosier dogwood, eastern redcedar, blue spruce, American plum, common chokecherry, silver buffaloberry.	Norway spruce, white spruce.	Black walnut, jack pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
1373C: Omsrud-----	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Hawick-----	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, jack pine, Austrian pine.	Red pine, eastern white pine, Siberian elm.	---
1374: Havelock-----	---	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Silver maple, green ash, honeylocust, golden willow.	Eastern cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1375D: Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Ves-----	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, eastern redcedar, Norway spruce, Black Hills spruce, ponderosa pine, bur oak.	Hackberry, green ash, honeylocust, black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1376C: Omsrud-----	---	Siberian peashrub, redosier dogwood, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Storden-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
1382: Louis-----	Lilac-----	Siberian peashrub, eastern redcedar, common chokecherry.	Hackberry, white spruce, blue spruce, bur oak.	Siberian elm-----	Eastern cottonwood.
1386B: Amiret-----	---	Siberian peashrub, redosier dogwood, American plum, silver buffaloberry, lilac.	Eastern redcedar, Norway spruce, ponderosa pine, eastern white pine, bur oak.	Hackberry, green ash, honeylocust, black walnut, jack pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Swanlake-----	American plum-----	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Hawick-----	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, jack pine, Austrian pine.	Red pine, eastern white pine.	---
1388B: Terril-----	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, honeylocust, eastern redcedar, Norway spruce, Black Hills spruce.	Hackberry, green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1389: Havelock-----	---	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow, black willow.	Silver maple, eastern cottonwood.
1390: Leen-----	Redosier dogwood	Eastern redcedar, blue spruce, American plum, common chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
1392B: Grogan-----	---	Siberian peashrub, gray dogwood, redosier dogwood, American plum, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, blue spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
1802: Calcousta-----	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce, bur oak.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Silver maple, black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, black willow.	Eastern cottonwood.
1833, 1834: Coland-----	---	Redosier dogwood, cotoneaster, American plum.	Hackberry, white spruce, northern whitecedar.	Green ash, black willow.	Silver maple, eastern cottonwood.
1845A: Estherville-----	Siberian peashrub	Eastern redcedar, Black Hills spruce, lilac.	Green ash, Norway spruce, jack pine, Austrian pine, red pine.	Eastern white pine, Scotch pine, eastern cottonwood.	---
1845B: Estherville-----	Siberian peashrub	Eastern redcedar, Black Hills spruce, lilac.	Green ash, honeylocust, Norway spruce, Austrian pine, red pine.	Eastern white pine, Scotch pine, eastern cottonwood.	---

WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1900: Okoboji-----	---	Redosier dogwood, silver buffaloberry.	Black ash, green ash, tamarack, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
Canisteeo-----	---	Redosier dogwood	Black ash, tall purple willow.	White willow, golden willow, black willow.	---
1958: Danube-----	Redosier dogwood	American plum, common chokecherry, lilac.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash-----	Siouxland cottonwood.
1999: Minneiska-----	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
Rushriver-----	---	Redosier dogwood, American plum.	Hackberry, eastern redcedar, white spruce, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.

WINDBREAK SUITABILITY GROUPS

(Suitable shrubs and trees with their mature heights are listed in the "Windbreaks and Environmental Plantings" table. Absence of an entry indicates that a windbreak suitability group is not assigned)

Map symbol and soil name	Windbreak suitability group
27A, 27B----- Dickinson	5
35----- Blue Earth	2W
39A, 39B----- Wadena	6G
85----- Calco	2K
86----- Canisteo	2K
94C----- Terril	3
102B----- Clarion	3
112----- Harps	2K
113----- Webster	2
118----- Crippin	1K
128C2----- Grogan	3
130----- Nicollet	1
134----- Okoboji	2W
156----- Fairhaven	6G
211----- Lura	2W
227----- Lemond	2K
247----- Linder	1
255----- Mayer	2K
282----- Hanska	2

WINDBREAK SUITABILITY GROUPS--Continued

Map symbol and soil name	Windbreak suitability group
318----- Mayer	2K
327A, 327B, 327C----- Dickman	7
336----- Delft	2
386----- Okoboji	2W
392----- Biscay	2
423----- Seaforth	1K
446----- Normania	1
463A, 463B--- Minneiska	1K
519----- Klossner	2H
525----- Muskego	2H
539----- Klossner	2H
574----- Du Page	1
575----- Nishna	2K
595F----- Swanlake	8
610----- Calco	2K
770C2----- Ves-Terril	3
810----- Coriff- Fieldon	2K
817: Canisteo---	2K
Seaforth---	1K
875C----- Hawick- Estherville	7

WINDBREAK SUITABILITY GROUPS--Continued

Map symbol and soil name	Windbreak suitability group
887B:	
Clarion-----	3
Swanlake-----	8
899:	
Harps-----	2K
Okoboji-----	2W
920B:	
Clarion-----	3
Storden-----	8
Hawick-----	7
927:	
Harps-----	2K
Seaforth-----	1K
Okoboji-----	2W
954C2:	
Ves-----	3
Storden-----	8
956:	
Canisteo-----	2K
Glencoe-----	2W
960D2, 960F:	
Storden-----	8
Omsrud-----	3
978-----	2
Cordova- Rolfe	
999C2:	
Ves-----	3
Storden-----	8
Hawick-----	7
1080-----	10
Klossner- Okoboji- Glencoe	
1100-----	1
Nicollet	
1101-----	2
Webster	
1159B:	
Strout-----	4C

WINDBREAK SUITABILITY GROUPS--Continued

Map symbol and soil name	Windbreak suitability group
1159B: Arkton-----	1K
1162A----- Kandiyohi	4C
1169: Corvuso-----	2K
Lura-----	2W
1193----- Cosmos	2
1205: Leen-----	2K
Okoboji-----	2W
1242F: Swanlake-----	8
Terril-----	3
1261B----- Bechyn	10
1262----- Seaforth	1K
1267----- Cedarrock	2K
1268----- Hanlon	1
1269----- Lowlein	1
1270D: Bechyn----- Rock outcrop.	10
1285----- Chetomba	2
1286----- Prinsburg	2K
1287----- Calco	10
1355B: Amiret-----	3
Swanlake----	8
1369A, 1369B- Crooksford	1

WINDBREAK SUITABILITY GROUPS--Continued

Map symbol and soil name	Windbreak suitability group
1370B----- Amiret	3
1371B: Crooksford--	1
Swanlake----	8
1373C: Omsrud-----	3
Storden-----	8
Hawick-----	7
1374----- Havelock	2K
1375D: Storden-----	8
Ves-----	3
1376C: Omsrud-----	3
Storden-----	8
1382----- Louris	1K
1386B: Amiret-----	3
Swanlake----	8
Hawick-----	7
1388B----- Terril	3
1389----- Havelock	2K
1390----- Leen	2K
1392B----- Grogan	3
1802: Calcousta---	2K
Okoboji----	2W
1833, 1834--- Coland	2
1845A, 1845B- Estherville	7

WINDBREAK SUITABILITY GROUPS--Continued

Map symbol and soil name	Windbreak suitability group
1900----- Okobeji- Canisteo	2W
1917----- Nishna	10
1958----- Danube	2K
1999: Minneiska---	1K
Rushriver---	2K

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Recreation

The natural, scenic, and historic areas along the Minnesota River provide the foremost recreational opportunities in the county. The Minnesota River provides fishing and boating opportunities. Boat and canoe landings are located in several areas along the river. There are several county parks along the Minnesota River that allow camping or picnicking. Additional county parks are adjacent to Beaver Falls and Birch Cooley Creeks, and one is along Lake Allie in the northeastern part of the county. In addition to the Minnesota River, two lakes in the northeastern part of the county, Lake Allie and Preston Lake, offer fishing and boating opportunities. Winter recreational opportunities are available for snowmobiling, cross-country skiing, ice fishing, and hunting. Boating, fishing, and golfing are popular in summer. Golf courses are in Olivia, south of Fairfax, and on the north side of Lake Allie.

The soils of the survey area are rated in the table "Recreational Development" according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, the 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. The soils are rated on the basis of soil properties that influence the ease of developing camp areas and performance of the areas after development. Also considered are the soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land that are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the 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 that can withstand heavy foot traffic and maintain an adequate cover of vegetation. The soils are rated on the basis of soil properties that influence 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. The soils are rated on the basis of soil properties that influence 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.

The interpretive ratings in this table help engineers, planners, and others to 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 that soil properties are favorable for the rated use. The limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means that soil properties are moderately favorable for the rated use. The 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 that of soils rated *slight*.

Severe means that 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.

The information in the table "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 the table "Building Site Development" and interpretations for septic tank absorption fields in the table "Sanitary Facilities."

RECREATIONAL DEVELOPMENT

(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
27A: Dickinson-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
27B: Dickinson-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
35: Blue Earth-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
39A: Wadena-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
39B: Wadena-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
85: Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
86: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
94C: Terril-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
102B: Clarion-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
112: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
113: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
118: Crippin-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.
128C2: Grogan-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
130: Nicollet-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
134: Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
156: Fairhaven-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
211: Lura-----	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
227: Lemond-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
247: Linder-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.
255: Mayer-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
282: Hanska-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
318: Mayer-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
327A: Dickman-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
327B: Dickman-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
327C: Dickman-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
336: Delft-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
386: Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
392: Biscay-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
423: Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
446: Normania-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
463A: Minneiska-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
463B: Minneiska-----	Severe: flooding.	Slight-----	Moderate: slope.	Slight-----	Slight.
519: Klossner-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
525: Muskego-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
539: Klossner-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
574: Du Page-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight-----	Moderate: flooding.
575: Nishna-----	Severe: flooding, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
595F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
610: Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
770C2: Ves-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Terril-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
810: Coriff-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Fieldon-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
817: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
875C: Hawick-----	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight-----	Severe: droughty.
Estherville-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
887B: Clarion-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Swanlake-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
899: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
920B: Clarion-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Storden-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Hawick-----	Slight-----	Slight-----	Severe: small stones.	Slight-----	Severe: droughty.
927: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
954C2: Ves-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
956: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Glencoe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
960D2: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Omsrud-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
960F: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Omsrud-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
978: Cordova-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Rolfe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
999C2: Ves-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Hawick-----	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight-----	Severe: droughty.
1030: Pits.					
Udipsamments----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.
1080: Klossner-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Glencoe-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1100: Nicollet-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
1101: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1159B: Strout-----	Severe: too clayey.				
Arkton-----	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones.	Slight-----	Slight.
1162A: Kandiyohi-----	Severe: too clayey.				

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1169: Corvuso-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lura-----	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
1193: Cosmos-----	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
1205: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1242F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Terril-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1261B: Bechyn-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----	Severe: depth to rock.
1262: Seaforth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1267: Cedarrock-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1268: Hanlon-----	Severe: flooding.	Slight-----	Moderate: slope.	Slight-----	Slight.
1269: Lowlein-----	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Slight.
1270D: Bechyn-----	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, depth to rock.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: slope.	Severe: depth to rock.
1285: Chetomba-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1286: Prinsburg-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1287: Calco-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1355B: Amiret-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Swanlake-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
1356: Water.					
1369A, 1369B: Crooksford-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
1370B: Amiret-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1371B: Crooksford-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Slight.
Swanlake-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
1373C: Omsrud-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Hawick-----	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight-----	Severe: droughty.
1374: Havelock-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1375D: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Ves-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1376C: Omsrud-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1382: Louris-----	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.
1386B: Amiret-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Swanlake-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
Hawick-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
1388B: Terril-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1389: Havelock-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1390: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1392B: Grogan-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1802: Calcousta-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1833: Coland-----	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
1834: Coland-----	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
1845A: Estherville-----	Slight-----	Slight-----	Moderate: small stones.	Slight-----	Moderate: droughty.
1845B: Estherville-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
1900: Okoboji-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1900: Canisteeo-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1917: Nishna-----	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding, flooding.
1958: Danube-----	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
1999: Minneiska-----	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Rushriver-----	Severe: flooding, wetness.	Severe: wetness.	Severe: flooding.	Severe: wetness.	Severe: wetness, flooding.

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Wildlife Habitat

Don Schultz, area wildlife manager, Minnesota Department of Natural Resources, and Mark Oja, biologist, Natural Resources Conservation Service, helped prepare this section.

The soils of Renville County provide excellent habitat for various species of wildlife. Soils vary in their ability to produce habitat for specific kinds of wildlife, and there is a distinct relationship between the plants that a soil can support and the kinds of wildlife that are associated with these plants. Generally, soils that are the most productive for agriculture also have the most potential for wildlife.

Intensive agriculture is the major land use in the county, and this land use is reflected in the species of wildlife. The once abundant pothole sloughs have been drained and tilled for agricultural use. The present land use pattern has reduced the pheasant and duck populations because habitat for nesting and winter cover has been greatly reduced.

The soils, topography, and interspersed cover types along the Minnesota River Valley provide good habitat for many wildlife species, such as deer, fox, squirrels, cottontail rabbits, pheasants, waterfowl, and nongame species. Agriculture is limited because of frequent flooding, rock outcrops, and steep slopes. The potential of the soils in this area for future development of wildlife habitat is high.

Renville County has ten State-owned wildlife management areas, which make up about 860 acres. These management areas provide habitat for small game, deer, waterfowl, and upland game and nongame wildlife. They are open to the public for hunting and trapping. State and Federal long-term retirement programs provide an excellent opportunity for the reestablishment of upland and wetland wildlife habitat in the county. As a result of the Conservation Reserve Program, many areas of highly erodible soils now have a protective cover of grass, which provides habitat for wildlife (fig. 6).

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. 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 the existing plant cover, and fostering the natural establishment of desirable plants.

Elements of Wildlife Habitat

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are corn, soybeans, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are brome grass, timothy, orchardgrass, clover, alfalfa, wheatgrass, and birdsfoot trefoil.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestems, indiagrass, blueberry, goldenrod, lambsquarters, dandelions, blackberry, ragweed, wheatgrass, and nightshade.

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, and flooding. The length of the growing season also is important.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, box elder, birch, maple, green ash, willow, and American elm. Examples of fruit-producing shrubs that are suitable for planting or soils that have good potential for these plants are hawthorn, honeysuckle, American plum, redosier dogwood, chokecherry, highbush cranberry, elderberry, gooseberry, serviceberry, silver buffaloberry, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that provide habitat or supply food in the form of browse, seed, or fruit-like cones. Examples



Figure 6.—An area of Storden-Ves complex, 12 to 18 percent slopes, eroded, that has been enrolled in the Conservation Reserve Program. The cover of grass helps to control erosion and provides habitat for openland wildlife.

are pine, spruce, cedar, and tamarack.

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. Examples are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

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 smartweeds, wild millet, rushes, sedges, bulrushes, wild rice, arrowhead, waterplantain, cattail, prairie cordgrass, bluejoint grass, asters, and beggarticks.

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 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 permeability.

Kinds of Wildlife Habitat

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. The wildlife attracted to these areas include Hungarian partridge, ring-necked pheasant, bobwhite quail, sharp-tailed grouse, meadowlark, field sparrow, killdeer, 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 wild turkey, ruffed grouse, thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, white-tailed deer, black bear, and moose.



Figure 7.—This area along Beaver Creek provides a good mixture of wetland and upland habitat types. Havelock silt loam, 0 to 2 percent slopes, frequently flooded, is in the low areas adjacent to the creek.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas, bogs, or flood plains that support water-tolerant plants (fig. 7). The wildlife attracted to this habitat include ducks, geese, herons,

rails, kingfishers, muskrat, otter, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, sage grouse, and meadowlark.

WILDLIFE HABITAT

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
27A, 27B: Dickinson-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
35: Blue Earth-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Poor	Good	Fair.
39A, 39B: Wadena-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
85: Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
86: Canisteo-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
94C: Terril-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
102B: Clarion-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
112: Harps-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
113: Webster-----	Good	Good	Good	Fair	Poor	---	Good	Good	Good	Fair	Good	---
118: Crippin-----	Good	Good	Good	Good	Fair	---	Fair	Poor	Good	Good	Poor	---
128C2: Grogan-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
130: Nicollet-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
134: Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
156: Fairhaven-----	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	---
211: Lura-----	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
227: Lemond-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
247: Linder-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---

WILDLIFE HABITAT--Continued

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
255: Mayer-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
282: Hanska-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
318: Mayer-----	Fair	Fair	Poor	Poor	Poor	---	Good	Good	Fair	Poor	Good	---
327A, 327B, 327C: Dickman-----	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	---
336: Delft-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
386: Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
392: Biscay-----	Good	Good	Good	Good	Fair	---	Good	Good	Good	Fair	Good	---
423: Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
446: Normania-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
463A, 463B: Minneiska-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
519: Klossner-----	Good	Poor	Poor	Poor	Poor	---	Good	Good	Fair	Poor	Good	---
525: Muskego-----	Good	Fair	Poor	Poor	Poor	---	Good	Good	Fair	Poor	Good	---
539: Klossner-----	Good	Poor	Poor	Poor	Poor	---	Good	Good	Fair	Poor	Good	---
574: Du Page-----	Good	Good	Good	Good	Good	---	Poor	Fair	Good	Good	Poor	---
575: Nishna-----	Fair	Fair	Fair	Poor	Very poor.	---	Good	Good	Fair	Poor	Good	---
595F: Swanlake-----	Poor	Poor	Good	Fair	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.	---
610: Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
770C2: Ves-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---

WILDLIFE HABITAT--Continued

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
770C2: Terril-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
810: Coriff-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Fieldon-----	Good	Good	Good	Good	Fair	---	Good	Good	Good	Good	Good	---
817: Canisteo-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
875C: Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Estherville-----	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	---
887B: Clarion-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Swanlake-----	Good	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Fair	Very poor.	---
899: Harps-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
920B: Clarion-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Storden-----	Good	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Good	Fair	Very poor.	Very poor.
Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
927: Harps-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
954C2: Ves-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.

WILDLIFE HABITAT--Continued

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
956:												
Canisteo-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Glencoe-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
960D2:												
Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Omsrud-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	---
960F:												
Storden-----	Poor	Fair	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Omsrud-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	---
978:												
Cordova-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Rolfe-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good	---
999C2:												
Ves-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
1030:												
Pits.												
Udipsamments.												
1080:												
Klossner-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Good	Good	Very poor.	Very poor.	Good	---
Okoboji-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Good	Good	Very poor.	Very poor.	Good	---
Glencoe-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Good	Good	Very poor.	Very poor.	Good	---
1100:												
Nicollet-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
1101:												
Webster-----	Good	Good	Good	Fair	Poor	---	Good	Good	Good	Fair	Good	---
1159B:												
Strout-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Arkton-----	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---

WILDLIFE HABITAT--Continued

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
1162A: Kandiyohi-----	Fair	Fair	Fair	Good	Good	---	Poor	Poor	Poor	Fair	Poor	---
1169: Corvuso-----	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good	---
Lura-----	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
1193: Cosmos-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
1205: Leen-----	Good	Good	Fair	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
1242F: Swanlake-----	Poor	Poor	Good	Fair	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.	---
Terril-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	---
1261B: Bechyn-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
1262: Seaforth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
1267: Cedarrock-----	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
1268: Hanlon-----	Good	Good	Good	Good	Good	---	Poor	Fair	Good	Good	Poor	---
1269: Lowlein-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
1270D: Bechyn-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Rock outcrop----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---
1285: Chetomba-----	Good	Good	Fair	Fair	Poor	---	Good	Good	Good	Fair	Good	---
1286: Prinsburg-----	Good	Good	Fair	Fair	Poor	---	Good	Good	Good	Fair	Good	---
1287: Calco-----	Good	Fair	Good	Poor	Very poor.	---	Good	Good	Fair	Poor	Fair	---
1355B: Amiret-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---

WILDLIFE HABITAT--Continued

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
1355B: Swanlake-----	Good	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Fair	Very poor.	---
1356: Water.												
1369A, 1369B: Crooksford-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
1370B: Amiret-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
1371B: Crooksford-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---
Swanlake-----	Good	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Fair	Very poor.	---
1373C: Omsrud-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
1374: Havelock-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
1375D: Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Ves-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.	---
1376C: Omsrud-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden-----	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
1382: Louris-----	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Good.
1386B: Amiret-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.	---
Swanlake-----	Good	Good	Good	Fair	Fair	---	Poor	Very poor.	Good	Fair	Very poor.	---
Hawick-----	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
1388B: Terril-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor	---

WILDLIFE HABITAT--Continued

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
1329: Havelock-----	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
1390: Leen-----	Good	Good	Fair	Fair	Fair	Good	Good	Good	Good	Fair	Good	Good.
1392B: Grogan-----	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.	---
1802: Calcousta-----	Good	Good	Fair	Good	Good	---	Good	Good	Good	Good	Good	---
Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
1833: Coland-----	Good	Good	Good	Fair	Fair	---	Good	Good	Good	Fair	Good	---
1834: Coland-----	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Poor	Poor	Good	---
1845A, 1845B: Estherville-----	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.	---
1900: Okoboji-----	Fair	Fair	Fair	Fair	Very poor.	---	Good	Good	Fair	Fair	Good	---
Canisteo-----	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Poor	Good	---
1917: Nishna-----	Very poor.	Poor	Fair	Poor	Very poor.	---	Good	Good	Poor	Poor	Good	---
1958: Danube-----	Good	Good	Fair	Poor	Poor	---	Good	Good	Good	---	Good	---
1999: Minneiska-----	Poor	Fair	Fair	Good	Good	---	Poor	Poor	Fair	Good	Poor	---
Rushriver-----	Poor	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good	---

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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 kinds 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

The table "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, 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, the available water capacity in the upper 40 inches, and the content of salts 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

The table "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, 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.

The table “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, 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 and bedrock 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 the table “Sanitary Facilities” are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, 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 affect trench 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 wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock 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

The table "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 the table "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. The table showing 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, or slopes of more than 25 percent. They are wet and have 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 (fig. 8). They are used in many kinds of construction. Specifications for each use vary widely. In the table "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.

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.



Figure 8.—An area of Pits, gravel-Udipsamments complex, which is being actively used. Gravel pits are in areas of the Dickinson-Estherville-Linder association.

Water Management

The table “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 the table “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, 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, 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. 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. The performance of a system is affected by the depth of the root zone, the amount of salts, 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 affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion 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 affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

BUILDING SITE DEVELOPMENT

(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
27A: Dickinson-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Slight.
27B: Dickinson-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
35: Blue Earth-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
39A: Wadena-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
39B: Wadena-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
85: Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
86: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
94C: Terril-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
102B: Clarion-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
112: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
113: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
118: Crippin-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Moderate: wetness.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
128C2: Grogan-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
130: Nicollet-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
134: Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
156: Fairhaven-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Slight.
211: Lura-----	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
227: Lemond-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
247: Linder-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
255: Mayer-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
282: Hanska-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
318: Maysr-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
327A: Dickman-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
327B: Dickman-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
327C: Dickman-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
336: Delft-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
386: Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
392: Biscay-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness.
423: Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
446: Normania-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
463A: Minneiska-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
463B: Minneiska-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
519: Klossner-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
525: Muskego-----	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
539: Klossner-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
574: Du Page-----	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
575: Nishna-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
595F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
610: Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
770C2: Ves-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Terril-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
810: Coriff-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Fieldon-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
817: Canisteeo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
875C: Hawick-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: drougthy.
Estherville-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: drougthy, slope.
887B: Clarion-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
Swanlake-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
899: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
920B: Clarion-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
Storden-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
Hawick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: droughty.
927: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
954C2: Ves-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
956: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Glencoe-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
960D2, 960F: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Omsrud-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
978: Cordova-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
978: Rolfe-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
999C2: Ves-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Hawick-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
1030: Pits.						
Udipsamments----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1080: Klossner-----	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, low strength, ponding.	Severe: ponding, excess humus.
Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Glencoe-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
1100: Nicollet-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
1101: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1159B: Strout-----	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Arkton-----	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1162A: Kandiyohi-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
1169: Corvuso-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Lura-----	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
1193: Cosmos-----	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
1205: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1242F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Terril-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
1261B: Bechyn-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
1262: Seaforth-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
1267: Cedarrock-----	Severe: depth to rock, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
1268: Hanlon-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1269: Lowlein-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
1270D: Bechyn-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
1285: Chetomba-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1286: Prinsburg-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1287: Calco-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
1355B: Amiret-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Swanlake-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
1356: Water.						
1369A: Crooksford-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
1369B: Crooksford-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
1370B: Amiret-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1371B: Crooksford-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Swanlake-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
1373C: Omsrud-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Hawick-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
1374: Havelock-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
1375D. Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ves-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
1376C: Omsrud-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
1382: Louris-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Moderate: wetness.
1386B: Amiret-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Swanlake-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
Hawick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1388B: Terril-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Moderate: slope.	Severe: low strength.	Slight.
1389: Havelock-----	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, flooding.
1390: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1392B: Grogan-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.	Slight.
1802: Calcousta-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1833: Coland-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
1834: Coland-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
1845A: Estherville-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
1845B: Estherville-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
1900: Okoboji-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Canisteo-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.

BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1917: Nishna-----	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, flooding.
1958: Danube-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness, too clayey.
1999: Minneiska-----	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Rushriver-----	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.

SANITARY FACILITIES

(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
27A, 27B: Dickinson-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
35: Blue Earth-----	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
39A, 39B: Wadena-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
85: Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
86: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94C: Terril-----	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
102B: Clarion-----	Slight-----	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
112: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
113: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
118: Crippin-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
128C2: Grogan-----	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
130: Nicollet-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
134: Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
156: Fairhaven-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
211: Lura-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
227: Lemond-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
247: Linder-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
255: Mayer-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
282: Hanska-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
318: Mayer-----	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
327A, 327B: Dickman-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
327C: Dickman-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
336: Delft-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
386: Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
392: Biscay-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
423: Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
446: Normania-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
463A: Minneiska-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, depth to rock, seepage.	Severe: flooding, seepage, wetness.	Poor: too sandy.
463B: Minneiska-----	Severe: wetness.	Severe: seepage, wetness.	Severe: depth to rock, seepage.	Severe: seepage, wetness.	Poor: too sandy.
519: Klossner-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
525: Muskego-----	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
539: Klossner-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
574: Du Page-----	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding.	Good.
575: Nishna-----	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
595F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
610: Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
770C2: Ves-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Terril-----	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
810: Coriff-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
Fieldon-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
817: Canisteco-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
875C: Hawick-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Estherville-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
887B: Clarion-----	Slight-----	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Swanlake-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
899: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
899: Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
920B: Clarion-----	Slight-----	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Storden-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Hawick-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
927: Harps-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
954C2: Ves-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
956: Canisteo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Glencoe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
960D2, 960F: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Omsrud-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
978: Cordova-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
978: Rolfe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
999C2: Ves-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Hawick-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1030: Pits.					
Udipsamments----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
1080: Klossner-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Glencoe-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
1100: Nicollet-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1101: Webster-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1159B: Strout-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Arkton-----	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: hard to pack.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1162A: Kandiyohi-----	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
1169: Corvuso-----	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Lura-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1193: Cosmos-----	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1205: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1242F: Swanlake-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Terril-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1261B: Bechyn-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
1262: Seaforth-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
1267: Cedarrock-----	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: depth to rock, wetness.
1268: Hanlon-----	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness.
1269: Lowlein-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1270D: Bechyn-----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Rock outcrop----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
1285: Chetomba-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1286: Prinsburg-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1287: Calco-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1355B: Amiret-----	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Swanlake-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
1356: Water.					
1369A, 1369B: Crooksford-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1370B: Amiret-----	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
1371B: Crooksford-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Swanlake-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
1373C: Omsrud-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1373C: Hawick-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1374: Havelock-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1375D: Storden-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ves-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
1376C: Omsrud-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
1382: Louris-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1386B: Amiret-----	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Swanlake-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Hawick-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1388B: Terril-----	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
1389: Havelock-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1390: Leen-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1392B: Grogan-----	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Good.
1802: Calcousta-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1833, 1834: Coland-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
1845A, 1845B: Estherville-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1900: Okoboji-----	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Canistee-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1917: Nishna-----	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
1958: Danube-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
1999: Minneiska-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, depth to rock, seepage.	Severe: flooding, seepage, wetness.	Poor: too sandy.
Rushriver-----	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.

CONSTRUCTION MATERIALS

(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
27A, 27B: Dickinson-----	Good-----	Probable-----	Improbable: too sandy.	Fair: thin layer.
35: Blue Earth-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
39A, 39B: Wadena-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
85: Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
86: Canisteo-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
94C: Terril-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
102B: Clarion-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
112: Harps-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
113: Webster-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
118: Crippin-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
128C2: Grogan-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
130: Nicollet-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
134: Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
156: Fairhaven-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
211: Lura-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
227: Lemond-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
247: Linder-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, area reclaim.
255: Mayer-----	Poor: wetness.	Probable-----	Probable-----	Poor: small stones, area reclaim, wetness.
282: Hanska-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
318: Mayer-----	Poor: wetness.	Probable-----	Probable-----	Poor: small stones, area reclaim, wetness.
327A, 327B, 327C: Dickman-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
336: Delft-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
386: Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
392: Biscay-----	Poor: wetness.	Probable-----	Probable-----	Poor: area reclaim, wetness.
423: Seaforth-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
446: Normania-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
463A, 463B: Minneiska-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
519: Klossner-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
525: Muskego-----	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
539: Klossner-----	Poor: thin layer, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
574: Du Page-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
575: Nishna-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
595F: Swanlake-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
610: Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
770C2: Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Terril-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
810: Coriff-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Fieldon-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
817: Canisteco-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
817: Seaforth-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
875C: Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
Estherville-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
887B: Clarion-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Swanlake-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
899: Harps-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
920B: Clarion-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
927: Harps-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Seaforth-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
954C2: Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
954C2: Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
956: Canisteo-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Glencoe-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
960D2: Storden-----	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Omsrud-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
960F: Storden-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Omsrud-----	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
978: Cordova-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Rolfe-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
999C2: Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
1030: Pits.				
Udipsamments-----	Fair: slope.	Probable-----	Probable-----	Poor: too sandy, slope.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1080: Klossner-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Glencoe-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1100: Nicollet-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1101: Webster-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1159B: Strout-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Arkton-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1162A: Kandiyohi-----	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1169: Corvuso-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Lura-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1193: Cosmos-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1205: Leen-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1242F: Swanlake-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1242F: Terril-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1261B: Bechyn-----	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
1262: Seaforth-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1267: Cedarrock-----	Poor: depth to rock, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1268: Hanlon-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
1269: Lowlein-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
1270D: Bechyn-----	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Rock outcrop----	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock.
1285: Chetomba-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1286: Prinsburg-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1287: Calco-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1355B: Amiret-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Swanlake-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1356: Water.				

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1369A, 1369B: Crooksford-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1370B: Amiret-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1371B: Crooksford-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Swanlake-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1373C: Omsrud-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
1374: Havelock-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1375D: Storden-----	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ves-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
1376C: Omsrud-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Storden-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1382: Louris-----	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1386B: Amiret-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Swanlake-----	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Hawick-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
1388B: Terril-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1389: Havelock-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1390: Leen-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1392B: Grogan-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
1802: Calcousta-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1833, 1834: Coland-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
1845A, 1845B: Estherville-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
1900: Okoboji-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1900: Canisteo-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1917: Nishna-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1958: Danube-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too clayey, wetness.
1999: Minneiska-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
Rushriver-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.

WATER MANAGEMENT

(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	
27A: Dickinson-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable-----	Too sandy-----	Favorable.	
27B: Dickinson-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope-----	Too sandy-----	Favorable.	
35: Blue Earth-----	Moderate: seepage.	Severe: piping, humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
39A: Wadena-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable-----	Too sandy-----	Favorable.	
39B: Wadena-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope-----	Too sandy-----	Favorable.	
85: Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
86: Canisteo-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
94C: Terril-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope-----	Slope.	
102B: Clarion-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
112: Harps-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness, rooting depth.	Wetness-----	Wetness, rooting depth.	

WATER MANAGEMENT--Continued

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
113: Webster-----	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.
118: Crippin-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Erodes easily.
128C2: Grogan-----	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
130: Nicollet-----	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.
134: Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.
156: Fairhaven-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable-----	Erodes easily, too sandy.	Erodes easily.
211: Lura-----	Slight-----	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
227: Lemond-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.
247: Linder-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Rooting depth.
255: Mayer-----	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.

WATER MANAGEMENT--Continued

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	
282: Hanska-----	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.	
318: Mayer-----	Severe: seepage.	Severe: seepage, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding-----	Ponding, too sandy.	Wetness.	
327A: Dickman-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
327B: Dickman-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.	
327C: Dickman-----	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.	
336: Delft-----	Moderate: seepage.	Severe: thin layer, wetness.	Severe: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
386: Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
392: Biscay-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.	
423: Seaforth-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
446: Normania-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	

WATER MANAGEMENT--Continued

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
463A: Minneiska-----	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness-----	Wetness, too sandy.	Favorable.
463B: Minneiska-----	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness-----	Wetness, too sandy.	Favorable.
519: Klossner-----	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
525: Muskego-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
539: Klossner-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
574: Du Page-----	Severe: seepage.	Moderate: thin layer, piping.	Moderate: deep to water, slow refill.	Deep to water	Flooding-----	Favorable-----	Favorable.
575: Nishna-----	Slight-----	Severe: wetness.	Severe: slow refill.	Percs slowly, flooding.	Wetness, slow intake, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
595F: Swanlake-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
610: Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.
770C2: Ves-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
Terril-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope-----	Slope.

WATER MANAGEMENT--Continued

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	
810: Coriff-----	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.	
Fieldon-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.	
817: Canisteeo-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
Seaforth-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
875C: Hawick-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
Estherville---	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.	
887B: Clarion-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
Swanlake-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
899: Harps-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness, rooting depth.	Wetness-----	Wetness, rooting depth.	
Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
920B: Clarion-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	

WATER MANAGEMENT--Continued

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	
920B: Storden-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
Hawick-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy-----	Droughty.	
927: Harps-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness, rooting depth.	Wetness-----	Wetness, rooting depth.	
Seaforth-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
954C2: Ves-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
956: Canisteeo-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
Glencoe-----	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
960D2, 960F: Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Omsrud-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
978: Cordova-----	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
Rolfe-----	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.	

WATER MANAGEMENT--Continued

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	
999C2: Ves-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Hawick-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
1030: Pits.								
Udipsamments-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.	
1080: Klossner-----	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding-----	Ponding-----	Wetness.	
Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Erodes easily, ponding.	Wetness, erodes easily.	
Glencoe-----	Moderate: seepage.	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
1100: Nicollet-----	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.	
1101: Webster-----	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Wetness-----	Wetness.	
1159B: Strout-----	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, slow intake.	Erodes easily, wetness.	Erodes easily, rooting depth.	

WATER MANAGEMENT--Continued

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
1159B: Arkton-----	Moderate: slope.	Moderate: piping, hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily, rooting depth.
1162A: Kandiyohti-----	Slight-----	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, slow intake.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
1169: Corvuso-----	Slight-----	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
Lura-----	Slight-----	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
1193: Cosmos-----	Slight-----	Severe: wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.
1205: Leen-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.
Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.
1242F: Swanlake-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
Terril-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope-----	Slope.
1261B: Bechyn-----	Severe: depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Slope, depth to rock.	Depth to rock	Depth to rock.
1262: Seaforth-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Wetness-----	Favorable.

WATER MANAGEMENT--Continued

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	
1267: Cedarrock-----	Moderate: depth to rock.	Severe: wetness.	Severe: no water.	Depth to rock, flooding, frost action.	Wetness, depth to rock.	Depth to rock, wetness.	Wetness, depth to rock.	
1268: Hanlon-----	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Favorable-----	Favorable-----	Favorable.	
1269: Lowlein-----	Severe: seepage.	Severe: piping.	Severe: no water.	Favorable-----	Wetness-----	Erodes easily, wetness.	Erodes easily.	
1270D: Bechyn-----	Severe: depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.	
Rock outcrop----	Severe: depth to rock.	Slight-----	Severe: no water.	Deep to water	Depth to rock	Depth to rock	Depth to rock.	
1285: Chetomba-----	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.	
1286: Prinsburg-----	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.	
1287: Calco-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
1355B: Amiret-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
Swanlake-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
1356: Water.								

WATER MANAGEMENT--Continued

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	
1369A: Crooksford-----	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Erodes easily.	
1369B: Crooksford-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.	
1370B: Amiret-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
1371B: Crooksford-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.	
Swanlake-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
1373C: Omsrud-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Hawick-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.	
1374: Havelock-----	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
1375D: Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
Ves-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
1376C: Omsrud-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	

WATER MANAGEMENT--Continued

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	
1376C: Storden-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.	
1382: Louris-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Erodes easily.	
1386B: Amiret-----	Moderate: seepage, slope.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
Swanlake-----	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope-----	Erodes easily	Erodes easily.	
Hawick-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.	
1388B: Terril-----	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope-----	Favorable-----	Favorable.	
1389: HaveLock-----	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	
1390: Leen-----	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness-----	Erodes easily, wetness.	Wetness, erodes easily.	
1392B: Grogan-----	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Favorable-----	Erodes easily	Erodes easily.	
1802: Calcousta-----	Moderate: seepage.	Severe: piping, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding-----	Erodes easily, ponding.	Wetness, erodes easily.	
Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
1833, 1834: Coland-----	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness-----	Wetness.	

WATER MANAGEMENT--Continued

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	
1845A: Estherville-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty-----	Too sandy-----	Droughty.	
1845B: Estherville-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy-----	Droughty.	
1900: Okoboji-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
Canisteo-----	Moderate: seepage.	Severe: ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.	
1917: Nishna-----	Slight-----	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, flooding.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.	
1958: Danube-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action, cutbanks cave.	Wetness, slow intake.	Erodes easily, wetness, too sandy.	Wetness, erodes easily.	
1999: Minneiska-----	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness-----	Wetness, too sandy.	Favorable.	
Rushriver-----	Severe: seepage.	Severe: piping, wetness.	Moderate: cutbanks cave.	Flooding, frost action.	Wetness-----	Wetness-----	Wetness.	

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Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

The table "Engineering Index Properties" gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

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. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

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 oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are 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 and Chemical Properties

The tables "Physical Properties of the Soils" and "Chemical Properties of the Soils" show estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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 in Part I of this survey.

Clay as a soil separate, or component, 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 that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, 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 (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In the table "Physical Properties of the Soils," the estimated moist bulk

density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone.

The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The 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 the table “Physical Properties of the Soils,” the estimated content of organic matter 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 the available water capacity, infiltration rate, 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. 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 based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. 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 indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

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.

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.

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.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams that have more than 5 percent finely divided calcium carbonate. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils have less than 5 percent finely divided calcium carbonate. They are moderately erodible. Crops can be grown if measures to control wind erosion are used.

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 have less than 5 percent finely divided calcium carbonate. They are moderately erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils have less than 5 percent finely divided calcium carbonate. They are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index factor (I) is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles.

In the table “Chemical Properties of the Soils,” *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. It is a measurement of the nutrient-holding capacity of the soil.

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 is expressed as a weighted percentage of the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients, such as phosphorus, is affected by the amount of carbonates in the soil.

Gypsum is expressed as the percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Soils high in gypsum, such

as those more than 10 percent gypsum, may collapse if the gypsum is removed by percolating water. Gypsum is corrosive to concrete. Corrosion of concrete is most likely to occur in soils that are more than about 1 percent gypsum when wetting and drying occur.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Water Features

The table "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, when saturated, have the same runoff potential under similar storm and ground cover conditions. The soil properties that affect the runoff potential are those that influence the minimum 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 chiefly 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 chiefly of moderately deep or deep, moderately well drained or well drained soils that have a 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 chiefly 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 chiefly 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 in the table, the first letter is for drained areas and the second is for undrained areas.

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.

The table "Water Features" gives the frequency and duration of flooding and the time of year when flooding is most likely to occur. Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as none, rare, occasional, or frequent. *None* means flooding is not probable; *rare* that it is unlikely but is possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is 50 percent in any year).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 to 30 days), and *very long* (more than 30 days). The time of year that flooding is most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 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.

High water table (seasonal) is a zone of saturation at the highest average depth during the wettest season. 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. Indicated in the table "Water Features" are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An *apparent* water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time for adjustments in the surrounding soil.

A *perched* water table is one that is above an unsaturated zone in the soil. The basis for determining that a water table is perched may be general knowledge of the area. The water table is proven to be perched if the water level in a borehole is observed to fall when the borehole is extended.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Soil Features

The table "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.

Depth to bedrock is given if bedrock is within a depth of 60 inches. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually

over a period of several years. The table "Soil Features" shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

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 content, texture, moisture content, and acidity of the soil.

Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

ENGINEERING INDEX PROPERTIES

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
27A: Dickinson-----	In 0-17 17-32	Loam----- Fine sandy loam, sandy loam.	ML, CL-ML, CL A-4 SM, SC, SC-SM A-4		0 0	0 0	100 100	100 100	85-95 85-95	50-60 35-50	15-30 15-30	NP-10 NP-10
	32-38	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SC-SM A-2, A-3		0	0	100	100	80-95	5-20	10-20	NP-5
	38-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM A-3, A-2		0	0	100	100	70-90	5-20	0-14	NP
27B: Dickinson-----	0-15 15-29	Loam----- Fine sandy loam, sandy loam.	ML, CL-ML, CL A-4 SM, SC, SC-SM A-4		0 0	0 0	100 100	100 100	85-95 85-95	50-60 35-50	15-30 15-30	NP-10 NP-10
	29-60	Sand, loamy fine sand, loamy sand.	SM, SP-SM A-3, A-2		0	0	100	100	70-90	5-20	0-14	NP
35: Blue Earth-----	0-22 22-60	Mucky silt loam Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML OL, ML	A-5 A-5	0 0	0 0	95-100 95-100	95-100 80-100	85-95 80-95	80-95 80-95	41-50 41-50	2-8 2-8
39A: Wadena-----	0-18 18-37	Loam----- Loam, sandy loam, sandy clay loam.	ML SM, ML, CL, SC	A-4 A-4, A-6	0 0	0 0	95-100 95-100	90-100 80-100	75-95 75-95	50-65 40-60	25-40 25-40	2-10 5-12
	37-60	Stratified sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM A-1, A-3, A-2		0-3	0-5	45-100	35-100	10-80	2-10	---	NP
39B: Wadena-----	0-14 14-30	Loam----- Loam, sandy loam, sandy clay loam.	ML SM, ML, CL, SC	A-4 A-4, A-6	0 0	0 0	95-100 95-100	90-100 80-100	75-95 75-95	50-65 40-60	25-40 25-40	2-10 5-12
	30-60	Stratified sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM A-1, A-3, A-2		0-3	0-5	45-100	35-100	10-80	2-10	---	NP

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200	
85: Calco-----	In 0-14 14-40 40-60	Silty clay loam Silty clay loam Silty clay loam, loam, clay loam.	CH, CL CL, CH CL	A-7 A-7 A-7, A-6	0 0 0	0 0 0	100 100 100	95-100 95-100 90-100	85-100 85-100 80-100	40-60 40-60 30-45	15-30 15-30 10-20
86: Canisteo-----	0-20 20-23	Clay loam----- Clay loam, loam, silty clay loam.	OL, CL CL	A-7 A-6, A-7	0 0	0 0	95-100 98-100	95-100 90-100	85-100 85-100	40-50 38-50	15-20 25-35
94C: Terril-----	23-38 38-60	Clay loam, loam Clay loam, loam	CL, ML CL	A-6 A-6	0 0	0-5 0-5	90-100 95-100	80-95 90-98	60-95 80-95	30-40 30-40	5-15 12-20
102B: Clarion-----	0-23 23-50 50-60	Loam----- Loam, clay loam Clay loam, loam, sandy loam.	CL CL, CL-ML CL, SC, SC-SM, CL-ML	A-6 A-6, A-7 A-6, A-4	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-100 90-100 90-100	70-90 70-90 65-95	30-40 30-45 20-40	10-20 10-25 5-20
112: Harps-----	0-13 13-30 30-60	Loam----- Loam, sandy loam. Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML, SC, SC-SM	A-4, A-6 A-4, A-6 A-4, A-6	0 0 0	0-5 0-5 0-5	95-100 90-100 90-100	95-100 85-100 85-98	75-90 75-90 70-80	25-40 25-40 25-40	5-15 5-15 5-15
113: Webster-----	0-16 16-32 32-60	Clay loam----- Clay loam, silty clay loam, loam. Loam, clay loam	CL, CH CL CL, CL-ML, SC	A-7, A-6 A-6, A-7 A-6, A-4	0 0 0	0-5 0-5 0-5	95-100 95-100 90-100	95-100 95-100 90-100	85-95 85-95 75-90	35-45 35-45 25-35	15-25 15-25 8-15
118: Crippin-----	0-10 10-26 26-60	Loam----- Loam, clay loam Loam, clay loam	CL CL CL	A-6, A-7 A-6 A-6	0 0 0	0 0-5 2-5	95-100 95-100 90-100	95-100 90-100 85-98	80-90 80-90 75-90	30-45 30-40 30-40	10-20 10-20 10-20

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct						Pct
128C2: Grogan-----	0-13	Silt loam-----	ML	A-4	0	0	100	100	95-100	70-90	20-40	NP-10
	13-35	Loam, silt loam, very fine sandy loam.	ML	A-4	0	0	100	100	95-100	70-95	20-40	NP-10
	35-60	Stratified loamy very fine sand to silt loam.	ML	A-4	0	0	100	100	90-100	65-95	20-30	NP-5
130: Nicollet-----	0-16	Clay loam-----	ML, CL	A-6, A-7	0-1	0-5	95-100	90-100	85-100	55-85	35-50	10-25
	16-35	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-1	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	35-60	Loam, clay loam	CL	A-6	0-1	0-5	95-100	90-100	75-90	50-75	30-40	15-25
134: Okoboji-----	0-8	Silty clay loam	CH	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	8-28	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
156: Fairhaven-----	0-18	Silt loam-----	ML, CL	A-4, A-6	0	0	95-100	95-100	80-95	60-85	25-40	NP-15
	18-33	Silt loam, loam, silty clay loam.	ML, CL	A-4, A-6	0	0	95-100	95-100	80-95	60-85	25-40	2-15
	33-60	Stratified gravelly coarse sand to sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	50-100	35-100	20-50	1-10	----	NP
211: Lura-----	0-8	Silty clay-----	CH, OH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	8-39	Silty clay, clay.	OH, CH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	39-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	0	100	100	95-100	90-100	40-75	15-45

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
					Pct	Pct	Pct				Pct	
227: Lemond-----	0-12 12-34	Loam----- Sandy loam, loamy sand, loam.	ML, CL, CL-ML SM, SC-SM	A-4 A-2, A-4	0 0	0 0	95-100 95-100	95-100 95-100	80-95 65-80	50-65 25-50	15-25 15-25	2-10 NP-7
	34-60	Sand, coarse sand, loamy sand.	SP-SM, SP	A-3, A-1, A-2	0	0	90-100	85-100	35-85	2-10	---	NP
247: Linder-----	0-18 18-30 30-60	Loam----- Sandy loam----- Gravelly loamy sand, loamy coarse sand.	CL SC, SC-SM SP, SP-SM	A-4, A-6 A-2, A-4 A-1	0 0 0	0 0 0	100 95-100 75-95	95-100 80-100 30-95	80-95 45-75 25-50	50-80 30-45 2-12	25-40 20-30 0-14	8-15 5-10 NP
255: Mayer-----	0-21 21-37	Loam----- Sandy clay loam, silt loam, clay loam.	CL, ML CL, SC, ML, SM	A-6, A-4 A-6, A-4	0 0	0-2 0-10	95-100 65-95	85-100 45-85	70-90 20-45	50-85 2-10	30-40 30-40	5-20 5-15
	37-60	Gravelly coarse sand, sand, coarse sand.	SP, SW, SP-SM	A-1	0-1	0-10	65-95	45-85	20-45	2-10	15-20	NP
282: Hanska-----	0-17 17-26	Loam----- Sandy loam, coarse sandy loam, loam, loamy sand, loamy coarse sand.	ML, CL, CL-ML SM, SC-SM, SC	A-4 A-4	0 0	0 0	95-100 95-100	95-100 95-100	80-95 65-80	50-65 35-50	15-25 15-20	2-10 2-8
	26-31	Loamy sand, loamy coarse sand.	SP-SM, SM	A-2, A-3	0	0	95-100	90-100	50-75	5-25	15-20	NP
	31-60	Sand, coarse sand.	SP-SM	A-3, A-1, A-2	0	0	95-100	85-100	45-70	5-10	15-20	NP
318: Mayer-----	0-23 23-33	Clay loam----- Sandy clay loam, silt loam, clay loam.	CL, ML CL, SC, ML, SM	A-6, A-4 A-6, A-4	0 0	0-2 0-5	95-100 90-100	85-100 85-100	70-90 70-90	50-85 40-85	30-40 30-40	5-20 5-15
	33-60	Gravelly coarse sand, sand, coarse sand.	SP, SW, SP-SM	A-1	0-1	0-10	65-95	45-85	20-45	2-10	15-20	NP

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index	
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200			
327A: Dickman-----	0-14	Sandy loam-----											
	14-20	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0	95-100	95-100	55-95	25-40	20-30	2-8	
	20-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	0	95-100	75-100	50-80	5-10	0-14	NP	
327B: Dickman-----	0-11	Sandy loam-----											
	11-20	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0	95-100	95-100	55-95	25-40	20-30	2-8	
	20-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	0	95-100	75-100	50-80	5-10	0-14	NP	
327C: Dickman-----	0-8	Sandy loam-----											
	8-16	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0	95-100	95-100	55-95	25-40	20-30	2-8	
	16-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	0	95-100	75-100	50-80	5-10	0-14	NP	
336: Delft-----	0-19	Loam-----											
	19-30	Loam, clay loam, silty clay loam.	CL, ML CL, ML	A-6, A-7 A-6, A-7	0	0	95-100	90-100	75-90	60-80	30-45	10-20	
	30-49	Loam, clay loam, silt loam.	CL, ML	A-6, A-4	0	0	95-100	90-100	70-90	50-75	25-40	7-15	
49-60	Loam, clay loam, sandy loam.	CL, ML, CL-ML	A-6, A-4	0	0-5	90-100	85-100	55-90	50-85	20-40	3-15		

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
386: Okoboji-----	0-13 13-35 35-60	Mucky silty clay loam. Silty clay loam, silty clay. Silty clay loam, silty clay.	MH CH, CL CH, CL	A-7 A-7 A-7	0 0 0	0 0 0	100 100 95-100	100 100 95-100	95-100 90-100 90-100	90-95 80-95 80-95	35-45 50-60 50-60	15-25 30-35 30-35
392: Biscay-----	0-17 17-24 24-60	Loam----- Loam, clay loam, sandy clay loam. Stratified loamy sand to gravelly coarse sand.	CL, ML CL, ML SP, SP-SM, GP, GP-GM	A-7, A-6 A-6, A-7 A-1	0 0 0	0 0 0	95-100 95-100 45-95	95-100 90-100 35-95	70-95 70-90 20-45	50-80 50-75 2-10	35-50 30-50 ---	10-25 10-20 NP
423: Seaforth-----	0-8 8-23 23-60	Loam----- Loam, clay loam Loam-----	ML, CL CL CL	A-6 A-6 A-6	0 0 0	0 0 0	95-100 90-100 90-100	90-97 90-97 90-95	80-95 80-95 80-90	60-80 55-80 55-80	30-38 30-39 30-36	11-18 11-18 11-15
446: Normania-----	0-14 14-20 20-29 29-60	Loam----- Loam, clay loam Loam, clay loam Loam, clay loam	CL CL CL CL	A-6 A-6 A-6 A-6	0 0 0 0	0 0 0 0	95-100 95-100 90-100 90-100	90-98 90-98 90-98 90-98	75-85 80-95 80-90 80-90	60-80 55-85 55-80 55-80	32-36 32-41 32-41 32-41	12-15 13-20 13-20 13-20
463A: Minneiska-----	0-9 9-60	Silt loam----- Stratified silt loam to sand.	ML, CL, CL-ML SM, ML	A-4 A-4	0 0	0 0	100 100	95-100 85-100	70-90 50-90	50-75 35-60	20-35 15-20	3-10 NP-4
463B: Minneiska-----	0-10 10-60	Loam----- Stratified silt loam to sand.	ML, CL, CL-ML SM, ML	A-4 A-4	0 0	0 0	100 100	95-100 85-100	70-90 50-90	50-75 35-60	20-35 15-20	3-10 NP-4

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--					Liquid limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200			
	In				Pct	Pct						Pct	
519: Klossner-----	0-22 22-34	Muck----- Mucky silt loam, mucky silty clay loam.	PT MH	A-8 A-7	0 0	0 0	0 0	0 100	0 95-100	0 90-100	0 85-95	--- 60-90	NP 10-30
	34-47	Silt loam, silty clay loam.	CL-ML, CL	A-7, A-6	0	0	100	100	98-100	90-100	80-100	28-41	9-20
	47-60	Clay loam, loam	CL	A-6, A-7	0	0-5	95-100	85-98	70-85	55-70		32-41	13-20
525: Muskego-----	0-10 10-20	Muck----- Sapric material, muck.	PT PT	A-8 A-8	0 0	0 0	0 0	0 0	0 0	0 0		--- ---	NP NP
	20-60	Coprogenous earth.	OL	A-5	0	0	95-100	95-100	85-100	75-96		40-50	2-8
539: Klossner-----	0-20 20-29	Muck----- Mucky silt loam, mucky silty clay loam, silt loam.	PT MH	A-8 A-7	0 0	0 0	0 100	0 95-100	0 90-100	0 85-95	0	--- 60-90	NP 10-30
	29-60	Clay loam, loam, silty clay loam.	CL-ML, CL	A-7, A-6	0	0	95-100	90-100	80-100	60-90		35-65	20-30
574: Du Page-----	0-9 9-60	Loam----- Sandy loam, loam, gravelly sandy clay loam.	CL CL	A-6, A-7 A-4, A-6, A-7	0 0	0 0	95-100 85-100	95-100 75-100	90-100 65-100	70-95 55-95		30-45 25-45	11-21 7-20
575: Nishna-----	0-9 9-60	Silty clay----- Silty clay, silty clay loam.	CH, MH CH	A-7 A-7	0 0	0 0	100 100	100 100	95-100 95-100	90-100 90-100		55-65 60-70	25-35 30-40
595F: Swanlake-----	0-7 7-43 43-60	Loam----- Loam, clay loam Loam, clay loam	CL, ML CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	90-100 90-100 90-100	85-98 85-98 85-98	75-90 70-90 75-90	50-70 50-70 50-75		28-36 28-39 28-39	9-15 9-18 9-18

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index	
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200			
													Pct
610: Calco-----	0-7 7-44 44-60	Silty clay loam Silty clay loam Silty clay loam, loam, loam, clay loam.	CH, CL CL, CH CL	A-7 A-7 A-7, A-6		0 0 0	0 0 0	100 100 100	100 100 100	95-100 95-100 90-100	85-100 85-100 80-100	40-60 40-60 30-45	15-30 15-30 10-20
770C2: Ves-----	0-16 16-20 20-28 28-60	Loam----- Loam, clay loam Loam, clay loam Loam, clay loam	CL CL CL CL	A-6 A-6 A-6 A-6		0 0 0 0	0-5 0-5 0-5 0-5	95-100 95-100 90-100 90-100	90-98 90-98 90-98 90-98	80-95 80-95 80-90 80-90	60-80 55-75 55-80 55-80	30-39 30-41 30-41 30-41	11-18 11-20 11-20 11-20
Terril-----	0-36 36-45 45-60	Loam----- Loam, clay loam Clay loam, loam, sandy loam.	CL CL, CL-ML CL, SC, SC-SM, CL-ML	A-6 A-6, A-7 A-6, A-4		0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-100 90-100 90-100	70-90 70-90 65-95	60-80 60-80 35-85	30-40 30-45 20-40	10-20 10-25 5-20
810: Coriff-----	0-10 10-24	Loam----- Sandy loam, fine sandy loam.	ML, CL, CL-ML SC-SM, SM	A-4 A-4		0 0	0 0	90-100 90-100	85-100 85-100	80-90 60-80	50-80 35-50	20-30 15-20	2-10 NP-5
	24-33	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3		0	0	90-100	85-100	50-75	5-35	---	NP
	33-60	Loam, clay loam	CL-ML, CL	A-4, A-6		0	0-5	90-100	90-100	80-90	50-80	25-40	5-15
Fieldon-----	0-17 17-27	Fine sandy loam Fine sandy loam, very fine sandy loam, loam.	SM, SC-SM ML, SM	A-4 A-4		0 0	0 0	100 100	100 100	70-85 70-90	35-50 35-60	15-20 15-30	NP-5 NP-5
817: Canisteeo-----	0-20 20-31	Silty clay loam Clay loam, loam, silty clay loam.	OL, CL CL	A-7 A-6, A-7		0 0	0 0	95-100 98-100	95-100 90-100	85-100 85-100	60-100 65-95	40-50 38-50	15-20 25-35
	31-38 38-60	Clay loam, loam Clay loam, loam Clay loam, loam	CL, ML CL	A-6 A-6		0 0	0-5 0-5	90-100 95-100	80-95 90-98	60-95 80-95	50-85 50-75	30-40 30-40	5-15 12-20

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
817: Seaforth-----	In 0-8 8-14 14-60	Loam----- Loam, clay loam Loam-----	ML, CL CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	95-100 90-100 90-100	90-97 90-97 90-95	80-95 80-95 80-90	60-80 55-80 55-80	30-38 30-39 30-36	11-18 11-18 11-15
875C: Hawick-----	0-8 8-12	Gravelly sandy loam. Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM SP-SM, SM	A-1, A-2, A-3 A-1, A-2, A-3	0-2 0-2	0-5 0-5	75-95 75-95	60-95 60-95	35-70 35-70	5-35 5-25	0-14 0-14	NP-4 NP
Estherville-----	12-60	Gravelly coarse sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
0-10 10-18	Sandy loam----- Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC SM, SC-SM, SC	A-2, A-4 A-2, A-4, A-1	0 0	0-5 0-5	90-100 85-100	80-100 80-95	50-75 40-75	25-50 15-45	20-30 20-30	2-10 2-8	2-10 2-8
18-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP	NP
887B: Clarion-----	0-16 16-31	Loam----- Loam, sandy loam.	CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6	0 0	0-5 0-5	95-100 90-100	95-100 85-100	75-90 75-90	50-75 50-75	25-40 25-40	5-15 5-15
31-60	Loam, clay loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-98	70-85	50-75	25-40	5-15	5-15
0-8 8-14 14-60	Loam----- Loam, clay loam Loam, clay loam	CL, ML CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	90-100 90-100 90-100	85-98 85-98 85-98	75-90 70-90 75-90	50-70 50-70 50-75	28-36 28-39 28-39	9-15 9-18 9-18	9-15 9-18 9-18
899: Harps-----	0-13 13-17 17-60	Clay loam----- Loam, clay loam Loam, clay loam	CL, CH CL, CH CL	A-6, A-7 A-6, A-7 A-6	0 0 0	0-5 0-5 0-5	95-100 95-100 90-100	95-100 95-100 85-98	80-90 80-90 70-80	65-80 65-80 50-75	35-55 30-60 25-35	15-35 10-20 8-15

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct						Pct
899: Okoboji-----	0-8	Silty clay loam	CH	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	8-28	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
920B: Clarion-----	0-14	Loam-----	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	14-26	Loam, sandy loam.	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	26-60	Loam, clay loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-98	70-85	50-75	25-40	5-15
Storden-----	0-9	Loam-----	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	9-36	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	36-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Hawick-----	0-10	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	10-15	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
927: Harps-----	0-18	Clay loam-----	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	35-55	15-35
	18-33	Loam, clay loam	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	30-60	10-20
	33-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-80	50-75	25-35	8-15
Seaforth-----	0-13	Loam-----	ML, CL	A-6	0	0-5	95-100	90-97	80-95	60-80	30-38	11-18
	13-24	Loam, clay loam	CL	A-6	0	0-5	90-100	90-97	80-95	55-80	30-39	11-18
	24-60	Loam-----	CL	A-6	0	0-5	90-100	90-95	80-90	55-80	30-36	11-15
Okoboji-----	0-9	Silty clay loam	CH	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	9-41	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
41-60	Silty clay loam, silty clay.	CH, CL	A-7	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
954C2: Ves	0-10	Loam	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	10-22	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	22-38	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
	38-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
Storden	0-7	Loam	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	7-20	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	20-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
956: Canisteo	0-16	Clay loam	OL, CL	A-7	0	0	95-100	95-100	85-100	60-100	40-50	15-20
	16-21	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	0	98-100	90-100	85-100	65-95	38-50	25-35
Glencoe	21-28	Clay loam, loam	CL, ML	A-6	0	0-5	90-100	80-95	60-95	50-85	30-40	5-15
	28-60	Clay loam, loam	CL	A-6	0	0-5	95-100	90-98	80-95	50-75	30-40	12-20
	0-10	Clay loam	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	35-45	15-20
	10-32	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
960D2: Storden	32-42	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	42-60	Loam, clay loam	CL, ML	A-6	0	0	90-100	85-100	60-95	55-75	30-40	10-20
	0-7	Loam	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	7-18	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Omsrud	18-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	0-9	Loam	CL, ML	A-6, A-2-6	0	0-5	95-100	90-98	85-95	55-75	30-35	11-15
	9-36	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-80	32-39	13-18
	36-60	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-85	32-39	13-18
960F: Storden	0-6	Loam	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	6-15	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	15-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Omsrud	0-9	Loam	CL, ML	A-6, A-2-6	0	0-5	95-100	90-98	85-95	55-75	30-35	11-15
	9-16	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-80	32-39	13-18
	16-60	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-85	32-39	13-18

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity index	
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
978: Cordova-----	0-22	Clay loam-----	CL, ML, MH, OH	A-6, A-7	0	0	95-100	95-100	90-100	70-85	38-60	12-25
	22-39	Silty clay loam, clay loam.	CL	A-7	0	0	90-100	90-100	85-95	65-90	40-50	20-30
	39-60	Clay loam, loam	CL	A-6	0	0-5	90-100	90-100	80-95	55-70	30-40	12-20
Rolfe-----	0-21	Silt loam-----	OL, CL, ML	A-6, A-4	0	0	100	95-100	90-100	80-95	30-40	5-15
	21-40	Clay, silty clay, clay loam.	CH	A-7	0	0	100	95-100	90-100	75-95	50-65	25-35
	40-60	Clay loam, loam	CL	A-7, A-6	0	0	95-100	90-100	80-90	55-75	30-45	10-20
999C2: Ves-----	0-8	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	8-25	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	25-40	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
	40-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
Storden-----	0-7	Loam-----	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	7-32	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	32-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Hawick-----	0-7	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	7-15	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	15-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
1030: Pits.												
Udipsamments-----	0-14	Sand-----	SM, SP-SM	A-2	0	0	95-100	85-100	75-90	10-35	---	NP
	14-60	Sand, fine sand	SP-SM, SP	A-2, A-3	0	0	95-100	85-100	50-75	5-25	---	NP
	60-80	Coarse sand, gravelly coarse sand.	SP, SP-SM, GP-GM	A-1, A-2	0	0	75-100	65-85	40-65	1-10	---	NP

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1080: Klossner-----	0-32	Muck-----	PT	A-8	0	0	0	0	0	0	0-14	NP
	32-60	Clay loam, loam, mucky silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	0	90-100	85-100	80-100	60-90	25-55	10-30
	0-17	Mucky silty clay loam.	MH	A-7	0	0	100	100	95-100	90-95	60-90	10-30
	17-48	Silty clay loam, silty clay.	CH	A-7	0	0	100	100	90-100	80-95	55-65	30-40
Okoboji-----	48-60	Silty clay loam, silty clay.	CH	A-7	0	0	95-100	95-100	90-100	80-95	55-65	30-40
	0-26	Silty clay loam	OL, OH, MH, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-55	10-25
Glencoe-----	26-30	Loam, clay loam, silty clay loam.	MH, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-50	10-25
	30-60	Loam, clay loam	CL, ML	A-6, A-7	0	0	90-100	85-100	60-95	55-75	30-50	10-20
	0-15 15-20	Silty clay loam Clay loam, loam, silty clay loam.	ML, CL CL	A-6, A-7 A-6, A-7	0-1 0-1	0-5 0-5	95-100 95-100	90-100 90-100	85-100 80-95	55-85 55-80	35-50 35-50	10-25 15-25
1100: Nicollet-----	20-60	Loam, clay loam	CL	A-6	0-1	0-5	95-100	90-100	75-90	50-75	30-40	15-25
	0-17 17-24	Silty clay loam Clay loam, silty clay loam, loam.	CL, CH CL	A-7, A-6 A-6, A-7	0 0	0-5 0-5	95-100 95-100	95-100 95-100	85-95 85-95	80-90 65-85	35-45 35-45	15-25 15-25
1101: Webster-----	24-60	Loam, clay loam	CL, CL-ML, SC	A-6, A-4	0	0-5	95-100	90-100	75-90	40-70	25-35	8-15
	0-10 10-23 23-60	Clay----- Clay loam, clay Clay loam, clay	CL, CH CL, CH CL, CH	A-7 A-7 A-7	0-1 0-2 0-2	0-2 0-4	98-100 95-100 95-100	95-100 90-100 90-100	90-100 75-95 70-95	75-95 70-95 70-95	45-60 45-60 40-55	20-35 20-30 20-30
1159B: Strout-----	0-9 9-25	Clay loam----- Clay, silty clay, clay loam.	CL CH, CL	A-7 A-7	0-1 0-1	0-3 0-3	95-100 95-100	85-100 85-100	75-100 70-95	65-95 70-95	40-50 40-60	15-25 15-35
	25-60	Clay loam, loam	CL, CH	A-6, A-7	0-1	0-3	95-100	85-100	70-100	55-90	35-60	11-30

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1162A: Kandiyohi-----	0-9	Clay-----	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-65	25-40
	9-21	Silty clay, silty clay loam, clay.	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-70	25-50
	21-46	Clay loam, silty clay, clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	90-95	75-95	50-70	20-45
	46-60	Clay loam, clay	CH, CL	A-7	0-2	2-5	95-100	95-98	80-95	70-95	45-70	20-45
1169: Corvuso-----	0-11	Clay loam-----	CH, MH	A-7	0-1	0-1	100	95-100	90-100	75-95	50-65	30-45
	11-28	Silty clay, clay, silty clay loam.	CH, MH	A-7	0-1	1-2	100	95-100	90-100	75-95	50-70	30-50
	28-60	Clay loam, clay, silty clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	80-95	70-95	45-70	25-45
Lura-----	0-9	Silty clay-----	CH, OH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	9-43	Silty clay, clay.	OH, CH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	43-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	0	100	100	95-100	90-100	40-75	15-45
1193: Cosmos-----	0-23	Silty clay-----	CH, MH	A-7	0-1	0-1	98-100	98-100	95-100	85-95	50-65	30-40
	23-38	Silty clay, silty clay loam, clay.	CH, MH	A-7	0-1	0-2	98-100	98-100	95-100	85-95	50-75	30-50
	38-60	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	0-4	95-100	95-98	90-95	70-95	40-60	18-35
1205: Leen-----	0-9	Silty clay loam	CL	A-6, A-7	0	0	100	100	85-100	70-95	36-43	15-21
	9-27	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	28-43	9-21
	27-36 36-60	Silt loam----- Loam, clay loam	ML, CL CL	A-4, A-6 A-6	0 0	0-5	100 90-100	100 85-98	90-100 75-90	80-95 50-75	28-36 28-43	9-15 9-21

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1205: Okoboji-----	0-32 32-38	Silty clay loam Silty clay loam, silty clay.	CH CH, CL	A-7 A-7	0 0	0 0	100 100	100 100	90-100 90-100	80-95 80-95	50-60 50-60	30-35 30-35
	38-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
1242F: Swanlake-----	0-9 9-15 15-60	Loam----- Loam, clay loam Loam, clay loam	CL, ML CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	90-100 90-100 90-100	85-98 85-98 85-98	75-90 70-90 75-90	50-70 50-70 50-75	28-36 28-39 28-39	9-15 9-18 9-18
	0-32 32-40 40-60	Loam----- Loam, clay loam Clay loam, loam, sandy loam.	CL CL, CL-ML CL, SC, SC-SM, CL-ML	A-6 A-6, A-7 A-6, A-4	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-100 90-100 90-100	70-90 70-90 65-95	60-80 60-80 35-85	30-40 30-45 20-40	10-20 10-25 5-20
1261B: Bechyn-----	0-15 15-18 18-60	Loam----- Loam, sandy loam, silt loam. Unweathered bedrock.	CL, ML SM, ML, CL ---	A-4, A-6 A-2, A-4, A-6 ---	0-1 0-1 ---	0-5 0-5 ---	95-100 95-100 ---	90-100 75-100 ---	70-90 55-75 ---	50-75 25-50 ---	20-35 20-35 ---	5-15 NP-15 NP
1262: Seaforth-----	0-16 16-44 44-60	Silt loam----- Loam, clay loam Loam-----	ML, CL CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	95-100 90-100 90-100	90-97 90-97 90-95	80-95 80-95 80-90	60-80 55-80 55-80	30-38 30-39 30-36	11-18 11-18 11-15
1267: Cedarrock-----	0-28 28-34 34-60	Silty clay loam Loam, clay loam, silty clay loam. Unweathered bedrock.	CL, ML CL, ML ---	A-7, A-6 A-6, A-7 ---	0-1 0-1 ---	0-5 0-5 ---	95-100 95-100 ---	95-100 90-100 ---	90-100 85-95 ---	70-85 65-85 ---	36-48 28-48 ---	15-25 10-20 NP

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In											
1268: Hanlon-----	0-14 14-48	Loam----- Fine sandy loam, sandy loam.	CL-ML, CL SC-SM, SC, SM	A-4, A-6 A-4	0 0	0 0	100 100	100 100	100 75-80	70-100 35-50	25-35 25-35	5-15 5-10
	48-60	Sandy loam, fine sandy loam, loamy fine sand.	SC-SM, SC	A-4, A-2	0	0	100	100	75-80	25-40	15-25	5-10
1269: Lowlein-----	0-15 15-32	Silt loam----- Sandy loam, fine sandy loam.	CL-ML, ML, CL SM, SC-SM	A-4, A-6 A-4, A-6	0 0	0 0	90-100 90-100	85-100 85-100	75-100 60-90	50-90 35-80	15-30 15-20	2-10 NP-5
	32-60	Loam, silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	0-5	90-100	85-100	80-90	55-80	25-40	5-15
1270D: Bechyn-----	0-9 9-15	Loam----- Loam, sandy loam, silt loam.	CL, ML SM, ML, CL	A-4, A-6 A-2, A-4, A-6	0-1 0-1	0-5 0-5	95-100 95-100	90-100 75-100	70-90 55-75	50-75 25-50	20-35 20-35	5-15 NP-15
	15-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	NP
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
1285: Chetomba-----	0-23 23-31	Silty clay loam Silty clay loam, silt loam.	ML CL, ML, CL-ML	A-7, A-6 A-7, A-6, A-4	0 0	0 0	100 100	100 100	100 100	90-100 90-100	35-45 25-45	15-20 10-20
	31-43	Silt loam, silty clay loam.	ML, CL, CL-ML	A-6, A-7, A-4	0	0	100	100	100	90-100	25-45	10-20
	43-60	Loam, clay loam	CL, CL-ML	A-6, A-4	0	0-5	90-100	85-95	80-90	55-80	30-40	10-20
1286: Prinsburg-----	0-19 19-36	Silty clay loam Silt loam, silty clay loam.	ML, OL ML, CL, CL-ML	A-7, A-6 A-7, A-6, A-4	0 0	0 0	100 100	100 100	100 100	90-100 90-100	35-45 25-45	15-20 10-20
	36-46	Silt loam, silty clay loam.	ML, CL, CL-ML	A-6, A-4	0	0	100	100	100	90-100	25-45	10-20
	46-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	85-95	80-90	55-80	30-40	10-20

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct						Pct
1287: Calco-----	0-7	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	7-41	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	41-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	0	100	100	90-100	80-100	30-45	10-20
1355B: Amiret-----	0-10	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	10-26	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	26-35	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
	35-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
	0-7	Loam-----	CL, ML	A-6	0	0-5	90-100	85-98	75-90	50-70	28-36	9-15
Swanlake-----	7-32	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-90	50-70	28-39	9-18
	32-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	75-90	50-75	28-39	9-18
1356: Water.												
1369A: Crooksford-----	0-15	Silt loam-----	CL, ML, CL-ML	A-4, A-6	0	0	100	100	85-100	70-90	28-36	9-15
	15-29	Silt loam, silty clay loam.	ML, CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	28-46	9-18
	29-36	Loam, silt loam	ML, CL	A-6, A-4	0	0	100	95-100	85-95	70-90	28-36	9-15
	36-60	Loam, clay loam	CL	A-6	0-1	0-5	90-100	85-95	75-90	50-75	28-46	9-18
1369B: Crooksford-----	0-15	Silt loam-----	CL, ML, CL-ML	A-4, A-6	0	0	100	100	85-100	70-90	28-36	9-15
	15-27	Silt loam, silty clay loam.	ML, CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	28-46	9-18
	27-43	Loam, silt loam	ML, CL	A-6, A-4	0	0	100	95-100	85-95	70-90	28-36	9-15
	43-60	Loam, clay loam	CL	A-6	0-1	0-5	90-100	85-95	75-90	50-75	28-46	9-18
1370B: Amiret-----	0-12	Loam-----	CL	A-6	0	0-5	95-100	90-98	80-95	60-80	30-39	11-18
	12-20	Loam, clay loam	CL	A-6	0	0-5	95-100	90-98	80-95	55-75	30-41	11-20
	20-30	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
	30-60	Loam, clay loam	CL	A-6	0	0-5	90-100	90-98	80-90	55-80	30-41	11-20
1371B: Crooksford-----	0-10	Silt loam-----	CL, ML, CL-ML	A-4, A-6	0	0	100	100	85-100	70-90	28-36	9-15
	10-25	Silt loam, silty clay loam.	ML, CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	28-46	9-18
	25-35	Loam, silt loam	ML, CL	A-6, A-4	0	0	100	95-100	85-95	70-90	28-36	9-15
35-60	Loam, clay loam	CL	A-6	0-1	0-5	90-100	85-95	75-90	50-75	28-46	9-18	

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquidity index	
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
												Pct
1371B: Swanlake	In 0-9 9-46 46-60	Loam Loam, clay loam Loam, clay loam	CL, ML CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	90-100 90-100 90-100	85-98 85-98 85-98	75-90 70-90 75-90	50-70 50-70 50-75	28-36 28-39 28-39	9-15 9-18 9-18
1373C: Omsrud	0-7 7-22 22-60	Loam Loam, clay loam Loam, clay loam	CL, ML CL, ML CL, ML	A-6, A-2-6 A-6, A-2-6 A-6, A-2-6	0 0 0	0-5 0-5 0-5	95-100 90-100 90-100	90-98 85-98 85-98	85-95 75-95 75-95	55-75 55-80 55-85	30-35 32-39 32-39	11-15 13-18 13-18
Storden	0-10 10-23 23-60	Loam Loam, clay loam Loam, clay loam	CL CL, ML CL, ML	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-98 90-98 90-98	75-95 70-95 70-95	60-75 55-70 55-70	28-36 28-39 28-39	9-15 9-18 9-18
Hawick	0-9 9-28	Gravelly sandy loam. Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM SP-SM, SM	A-1, A-2, A-3 A-1, A-2, A-3	0-2 0-2	0-5 0-5	75-95 75-95	60-95 60-95	35-70 35-70	5-35 5-25	0-14 0-14	NP-4 NP
1374: Havelock	28-60	Gravelly coarse sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
1375D: Storden	0-23 23-35 35-60	Clay loam Clay loam, silty clay loam. Loam, sandy loam, sandy clay loam.	CL, CH CL, CH CL, SC, CL-ML, SC-SM	A-7 A-7 A-4, A-6	0 0 0	0 0 0	100 100 100	100 100 90-100	95-100 95-100 60-70	65-85 65-85 40-60	45-55 45-55 20-40	20-30 20-30 5-15
1376C: Omsrud	0-9 9-24 24-60	Loam Loam, clay loam Loam, clay loam	CL CL, ML CL, ML	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-98 90-98 90-98	75-95 70-95 70-95	60-75 55-70 55-70	28-36 28-39 28-39	9-15 9-18 9-18
Ves	0-8 8-22 22-44 44-60	Loam Loam, clay loam Loam, clay loam Loam, clay loam	CL CL CL CL	A-6 A-6 A-6 A-6	0 0 0 0	0-5 0-5 0-5 0-5	95-100 95-100 90-100 90-100	90-98 90-98 90-98 90-98	80-95 80-95 80-90 80-90	60-80 55-75 55-80 55-80	30-39 30-41 30-41 30-41	11-18 11-20 11-20 11-20
1376C: Omsrud	0-10 10-29 29-60	Loam Loam, clay loam Loam, clay loam	CL, ML CL, ML CL, ML	A-6, A-2-6 A-6, A-2-6 A-6, A-2-6	0 0 0	0-5 0-5 0-5	95-100 90-100 90-100	90-98 85-98 85-98	85-95 75-95 75-95	55-75 55-80 55-85	30-35 32-39 32-39	11-15 13-18 13-18

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1376C: Storden-----	In 0-7 7-55 55-60	Loam----- Loam, clay loam Loam, clay loam	CL CL, ML CL, ML	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-98 90-98 90-98	75-95 70-95 70-95	60-75 55-70 55-70	28-36 28-39 28-39	9-15 9-18 9-18
1382: Louris-----	0-13 13-20	Silt loam----- Silt loam, silty clay loam.	CL, ML, CL-ML ML, CL, CL-ML	A-4, A-6 A-4, A-6	0 0	0 0	100 100	100 100	85-100 90-100	70-95 70-90	28-36 28-43	9-15 9-21
1386B: Amiret-----	0-12 12-20 20-50 50-60	Loam----- Loam, clay loam Loam, clay loam Loam, clay loam	CL CL CL CL	A-6 A-6 A-6 A-6	0 0 0 0	0-5 0-5 0-5 0-5	95-100 95-100 90-100 90-100	90-98 90-98 90-98 90-98	80-95 80-95 80-90 80-90	60-80 55-75 55-80 55-80	30-39 30-41 30-41 30-41	11-18 11-20 11-20 11-20
Swanlake-----	0-8 8-15 15-60	Loam----- Loam, clay loam Loam, clay loam	CL, ML CL CL	A-6 A-6 A-6	0 0 0	0-5 0-5 0-5	90-100 90-100 90-100	85-98 85-98 85-98	75-90 70-90 75-90	50-70 50-70 50-75	28-36 28-39 28-39	9-15 9-18 9-18
Hawick-----	0-8 8-13	Coarse sandy loam. Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SM SP-SM, SM CL, CL-ML	A-2 A-1, A-2, A-3	0-2 0-2	0-5 0-5	85-100 75-95	80-95 60-95	50-65 35-70	25-35 5-25	0-20 0-14	NP-4 NP
1388B: Terril-----	0-27 27-40 40-60	Loam----- Loam, clay loam Clay loam, loam	CL CL, CL-ML CL, CL-ML	A-6 A-6, A-7 A-6, A-7	0 0 0	0-5 0-5 0-5	95-100 95-100 95-100	95-100 90-100 90-100	70-90 70-90 65-95	60-80 60-80 50-85	30-40 30-45 20-40	10-20 10-25 5-20
1389: Havelock-----	0-30 30-40 40-60	Silt loam----- Clay loam, silty clay loam. Loam, sandy loam, sandy clay loam.	CL, CL-ML, ML CL, CH CL, SC, CL-ML, SC-SM	A-6, A-4 A-7 A-4, A-6	0 0 0	0 0 0	100 100 100	100 100 90-100	90-100 95-100 60-70	70-90 65-85 40-60	20-40 45-55 20-40	5-15 20-30 5-15

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct						Pct
1390: Leen-----	0-15	Silty clay loam	CL	A-6, A-7	0	0	100	100	85-100	70-95	36-43	15-21
	15-25	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	28-43	9-21
	25-38 38-60	Silt loam----- Loam, clay loam	ML, CL CL	A-4, A-6 A-6	0 0	0-5	100 90-100	100 85-98	90-100 75-90	80-95 50-75	28-36 28-43	9-15 9-21
1392B: Grogan-----	0-15	Silt loam-----	ML	A-4	0	0	100	100	95-100	70-90	20-40	NP-10
	15-38	Loam, silt loam	ML	A-4	0	0	100	100	95-100	70-95	20-40	NP-10
	38-60	Stratified loamy very fine sand to silt loam.	ML	A-4	0	0	100	100	90-100	65-95	20-30	NP-5
1802: Calcousta-----	0-12	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	40-65	20-40
	12-24	Silty clay loam, silt loam.	CH, CL	A-7	0	0	100	100	90-100	90-100	40-60	20-35
	24-60	Silty clay loam, silt loam.	CL, ML	A-6, A-4	0	0-5	95-100	95-100	85-100	80-90	30-40	5-15
Okoboji-----	0-6	Mucky silty clay loam.	MH	A-7	0	0	100	100	95-100	90-95	35-45	15-25
	6-32	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	32-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
1833: Coland-----	0-18	Clay loam-----	CL	A-7, A-6	0	0	100	100	95-100	65-80	35-50	15-25
	18-54	Clay loam, silty clay loam.	CL	A-7, A-6	0	0	100	100	95-100	65-80	35-50	15-25
	54-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	0	100	90-100	60-70	40-60	20-40	5-15

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit Pct	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1834: Coland-----	0-12 12-28	Clay loam----- Clay loam, silty clay loam.	CL	A-7, A-6 A-7, A-6	0	0	100	100	95-100	65-80	35-50	15-25
	28-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	0	100	90-100	60-70	40-60	20-40	5-15
1845A: Estherville-----	0-12 12-17	Loam----- Sandy loam, loam, coarse sandy loam.	CL-ML, CL SM, SC-SM, SC	A-4, A-6 A-2, A-4, A-1	0	0-5 0-5	90-100 85-100	80-100 80-95	50-75 40-75	50-60 15-45	25-40 20-30	4-15 2-8
	17-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP
1845B: Estherville-----	0-8 8-13	Loam----- Sandy loam, loam, coarse sandy loam.	CL-ML, CL SM, SC-SM, SC	A-4, A-6 A-2, A-4, A-1	0	0-5 0-5	90-100 85-100	80-100 80-95	50-75 40-75	50-60 15-45	25-40 20-30	4-15 2-8
	13-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP
1900: Okoboji-----	0-12 12-30	Mucky silty clay loam. Silty clay loam, silty clay.	MH CH, CL	A-7 A-7	0	0	100	100	95-100	90-95	35-45	15-25
	30-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
Canisteeo-----	0-19 19-23	Silty clay loam Clay loam, loam, silty clay loam.	ML, CL CL	A-7 A-6, A-7	0	0	95-100	95-100	85-100	60-100	40-50	15-20
	23-39	Clay loam, loam, sandy loam.	CL, SM, SC, ML	A-4, A-6	0	0-5	90-100	80-95	60-90	40-80	30-40	5-15
	39-60	Clay loam, loam	CL	A-6	0	0-5	95-100	90-100	80-95	60-75	30-40	12-20

ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth In	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit index	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1917: Nishna-----	0-21 21-60	Silty clay loam Silty clay, silty clay loam.	CH, MH CH	A-7 A-7	0 0	0 0	100 100	100 100	95-100 95-100	90-100 90-100	50-65 60-70	25-35 30-40
1958: Danube-----	0-19 19-31	Silty clay----- Silt loam, silty clay loam.	CL, CH, MH CL, CL-ML, ML	A-7 A-4, A-6, A-7	0 0	0 0	100 100	98-100 98-100	90-100 90-100	85-95 80-95	50-60 20-35	25-35 5-20
	31-35	Sandy loam, fine sandy loam, loam.	SM, SC-SM, ML	A-4, A-2-4	0	0	95-100	80-100	50-90	35-60	5-20	NP-5
	35-60	Loamy sand, gravelly sand, coarse sand.	SM, SP	A-1, A-2-4, A-3	0	0	90-100	55-95	35-65	5-25	---	NP
1999: Minneiska-----	0-7 7-60	Silt loam----- Stratified silt loam to sand.	ML, CL, CL-ML SM, ML	A-4 A-4	0 0	0	100 100	95-100 85-100	70-90 50-90	50-75 35-60	20-35 15-20	3-10 NP-4
	0-46 46-60	Loam----- Stratified silt loam to coarse sand.	ML, CL SP, SM, SC-SM, CL-ML	A-4, A-6 A-3, A-2, A-1, A-4	0 0	0-2	95-100 95-100	85-100 90-100	75-95 40-80	60-85 5-60	21-32 10-20	4-19 NP-5

PHYSICAL PROPERTIES OF THE SOILS

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
27A: Dickinson-----	0-17	10-18	1.50-1.55	2.00-6.00	0.12-0.15	Low-----	1.0-2.0	0.28	0.28	4	5	56
	17-32	10-15	1.45-1.55	2.00-6.00	0.12-0.15	Low-----	0.5-1.0	0.17	0.17			
	32-38	4-10	1.55-1.65	6.00-20.00	0.08-0.10	Low-----	0.0-0.5	0.20	0.20			
	38-60	4-10	1.60-1.70	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.15	0.15			
27B: Dickinson-----	0-15	10-18	1.50-1.55	2.00-6.00	0.12-0.15	Low-----	1.0-2.0	0.28	0.28	4	5	56
	15-29	10-15	1.45-1.55	2.00-6.00	0.12-0.15	Low-----	0.5-1.0	0.17	0.17			
	29-60	4-10	1.60-1.70	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.15	0.15			
35: Blue Earth-----	0-22	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Moderate	10-25	0.28	0.28	5	6	48
	22-60	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Low-----	10-25	0.28	0.28			
39A: Wadena-----	0-18	18-27	1.30-1.50	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	0.24	4	6	48
	18-37	18-30	1.35-1.50	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.32	0.32			
	37-60	1-5	1.55-1.65	>20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
39B: Wadena-----	0-14	18-27	1.30-1.50	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	0.24	4	6	48
	14-30	18-30	1.35-1.50	0.60-2.00	0.14-0.19	Low-----	0.5-1.0	0.32	0.32			
	30-60	1-5	1.55-1.65	>20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
85: Calco-----	0-14	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	14-40	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28			
	40-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32			
86: Canisteo-----	0-20	27-35	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	20-23	25-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	23-38	25-35	1.30-1.50	0.60-2.00	0.12-0.18	Low-----	0.5-1.0	0.32	0.32			
	38-60	22-30	1.45-1.60	0.60-2.00	0.14-0.16	Low-----	0.0-0.5	0.32	0.32			
94C: Terril-----	0-23	18-26	1.35-1.40	0.60-2.00	0.20-0.22	Low-----	3.0-5.0	0.24	0.24	5	6	48
	23-50	24-30	1.40-1.45	0.60-2.00	0.17-0.19	Low-----	2.0-3.0	0.28	0.28			
	50-60	15-30	1.45-1.70	0.60-2.00	0.16-0.18	Low-----	0.0-1.0	0.32	0.32			
102B: Clarion-----	0-13	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	0.24	5	6	48
	13-25	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.5-1.0	0.37	0.37			
	25-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.0-0.5	0.37	0.37			
112: Harps-----	0-13	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	3.0-5.0	0.24	0.24	5	4L	86
	13-30	24-35	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	1.0-3.0	0.32	0.32			
	30-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low-----	0.0-1.0	0.32	0.32			
113: Webster-----	0-16	26-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	4.0-7.0	0.24	0.24	5	6	48
	16-32	25-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	2.0-4.0	0.32	0.32			
	32-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Moderate	1.0-2.0	0.32	0.32			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
118: Crippin-----	0-10	22-27	1.35-1.40	0.60-2.00	0.20-0.22	Low-----	5.0-6.0	0.24	0.24	5	4L	86
	10-26	24-30	1.40-1.55	0.60-2.00	0.17-0.19	Low-----	1.0-4.0	0.28	0.28			
	26-60	22-30	1.35-1.55	0.60-2.00	0.17-0.19	Low-----	0.0-2.0	0.37	0.37			
128C2: Grogan-----	0-13	8-18	1.25-1.40	2.00-6.00	0.22-0.24	Low-----	2.0-4.0	0.32	0.32	5	5	56
	13-35	8-18	1.40-1.50	2.00-6.00	0.17-0.19	Low-----	1.0-2.0	0.43	0.43			
	35-60	5-15	1.50-1.60	2.00-6.00	0.17-0.19	Low-----	0.0-1.0	0.43	0.43			
130: Niccollet-----	0-16	27-35	1.15-1.25	0.60-2.00	0.17-0.22	Moderate	4.0-8.0	0.24	0.24	5	6	48
	16-35	25-35	1.25-1.35	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.32	0.32			
	35-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Low-----	0.0-1.0	0.32	0.32			
134: Okoboji-----	0-8	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	8-28	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	28-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
156: Fairhaven-----	0-18	18-27	1.25-1.40	0.60-2.00	0.22-0.24	Low-----	3.0-6.0	0.32	0.32	4	6	48
	18-33	18-30	1.30-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.43	0.43			
	33-60	0-5	1.55-1.65	6.00-20.00	0.02-0.04	Low-----	0.0-1.0	0.10	0.17			
211: Lura-----	0-8	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	4.0-12	0.28	0.28	5	4	86
	8-39	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	1.0-4.0	0.32	0.32			
	39-60	28-60	1.30-1.45	0.06-0.60	0.11-0.19	High-----	0.0-1.0	0.32	0.32			
227: Lemond-----	0-12	6-18	1.30-1.40	2.00-6.00	0.20-0.22	Low-----	4.0-8.0	0.24	0.24	4	4L	86
	12-34	6-18	1.35-1.50	2.00-6.00	0.10-0.13	Low-----	1.0-3.0	0.28	0.28			
	34-60	1-10	1.50-1.70	6.00-20.00	0.05-0.07	Low-----	0.0-1.0	0.15	0.15			
247: Linder-----	0-18	14-18	1.40-1.45	0.60-2.00	0.20-0.22	Low-----	3.0-4.0	0.24	0.24	4	5	56
	18-30	10-18	1.45-1.55	2.00-6.00	0.15-0.17	Low-----	0.0-0.5	0.24	0.24			
	30-60	2-8	1.55-1.75	>20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.20			
255: Mayer-----	0-21	18-30	1.25-1.35	0.60-2.00	0.20-0.22	Low-----	4.0-8.0	0.24	0.24	4	4L	86
	21-37	18-30	1.25-1.35	0.60-2.00	0.16-0.19	Low-----	2.0-6.0	0.28	0.28			
	37-60	1-5	1.55-1.65	6.00-20.00	0.02-0.04	Low-----	1.0-4.0	0.15	0.15			
282: Hanska-----	0-17	6-18	1.30-1.40	2.00-6.00	0.20-0.22	Low-----	4.0-8.0	0.28	0.28	4	5	56
	17-26	6-18	1.35-1.50	2.00-6.00	0.10-0.13	Low-----	2.0-4.0	0.28	0.28			
	26-31	2-10	1.50-1.60	6.00-20.00	0.08-0.10	Low-----	0.5-2.0	0.17	0.17			
	31-60	1-10	1.50-1.60	6.00-20.00	0.03-0.05	Low-----	0.0-0.5	0.17	0.17			
318: Mayer-----	0-23	18-30	1.25-1.35	0.60-2.00	0.20-0.22	Low-----	4.0-8.0	0.24	0.24	4	4L	86
	23-33	18-30	1.25-1.35	0.60-2.00	0.16-0.19	Low-----	2.0-6.0	0.28	0.28			
	33-60	1-5	1.55-1.65	6.00-20.00	0.02-0.04	Low-----	1.0-4.0	0.15	0.15			
327A: Dickman-----	0-14	6-18	1.30-1.40	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	3	3	86
	14-20	6-18	1.35-1.50	2.00-6.00	0.12-0.14	Low-----	0.0-1.0	0.20	0.20			
	20-60	1-10	1.50-1.60	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.15	0.15			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
327B: Dickman-----	0-11	6-18	1.30-1.40	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	3	3	86
	11-20	6-18	1.35-1.50	2.00-6.00	0.12-0.14	Low-----	0.0-1.0	0.20	0.20			
	20-60	1-10	1.50-1.60	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.15	0.15			
327C: Dickman-----	0-8	6-18	1.30-1.40	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.20	0.20	3	3	86
	8-16	6-18	1.35-1.50	2.00-6.00	0.12-0.14	Low-----	0.0-1.0	0.20	0.20			
	16-60	1-10	1.50-1.60	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.15	0.15			
336: Delft-----	0-19	24-27	1.40-1.55	0.60-2.00	0.18-0.20	Moderate	4.0-8.0	0.24	0.24	5	6	48
	19-30	18-35	1.40-1.55	0.20-2.00	0.19-0.22	Moderate	2.0-6.0	0.24	0.24			
	30-49	18-32	1.30-1.40	0.60-2.00	0.19-0.22	Low-----	1.0-4.0	0.32	0.32			
	49-60	15-32	1.40-1.55	0.20-2.00	0.15-0.19	Low-----	1.0-3.0	0.32	0.32			
386: Okoboji-----	0-13	20-30	1.20-1.25	0.60-2.00	0.22-0.25	Moderate	10-18	0.32	0.32	5	6	48
	13-35	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	35-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
392: Biscay-----	0-17	18-30	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	17-24	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	24-60	1-6	1.55-1.65	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.05	0.10			
423: Seaforth-----	0-8	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L	86
	8-23	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28			
	23-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.28	0.28			
446: Normania-----	0-14	18-27	1.20-1.35	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.24	0.24	5	6	48
	14-20	18-32	1.30-1.40	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.24	0.24			
	20-29	18-32	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.32	0.32			
	29-60	18-32	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.32	0.32			
463A: Minneiska-----	0-9	10-27	1.30-1.40	2.00-6.00	0.20-0.22	Low-----	2.0-5.0	0.28	0.28	5	4L	86
	9-60	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	1.0-2.0	0.28	0.28			
463B: Minneiska-----	0-10	10-27	1.30-1.40	2.00-6.00	0.20-0.22	Low-----	2.0-5.0	0.28	0.28	5	4L	86
	10-60	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	1.0-2.0	0.28	0.28			
519: Klossner-----	0-22	---	0.25-0.55	0.20-6.00	0.35-0.48	-----	25-60	---	---	2	2	134
	22-34	22-35	1.10-1.25	0.60-2.00	0.22-0.26	Moderate	10-20	0.37	0.37			
	34-47	18-32	1.30-1.40	0.20-2.00	0.18-0.22	Moderate	1.0-10	0.28	0.28			
	47-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	1.0-10	0.28	0.28			
525: Muskego-----	0-10	---	0.10-0.21	0.60-6.00	0.35-0.45	-----	60-90	0.10	0.10	1	2	134
	10-20	---	0.10-0.21	0.60-6.00	0.35-0.45	-----	60-90	0.10	0.10			
	20-60	18-35	0.30-1.10	0.06-0.20	0.18-0.24	Moderate	6.0-20	0.28	0.28			
539: Klossner-----	0-20	---	0.25-0.55	0.20-6.00	0.35-0.48	-----	25-60	---	---	2	2	134
	20-29	22-35	1.10-1.25	0.60-2.00	0.22-0.26	Moderate	10-20	0.37	0.37			
	29-60	22-35	1.30-1.40	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
574: Du Page-----	0-9	18-27	1.40-1.60	0.60-2.00	0.22-0.24	Moderate	3.0-5.0	0.28	0.28	5	6	48
	9-60	18-27	1.45-1.65	0.60-2.00	0.10-0.20	Low-----	0.1-2.0	0.28	0.32			
575: Nishna-----	0-9	40-44	1.30-1.35	0.06-0.20	0.12-0.14	High-----	4.0-6.0	0.37	0.37	5	4	86
	9-60	38-46	1.35-1.40	0.06-0.20	0.11-0.13	High-----	1.0-2.0	0.28	0.28			
595F: Swanlake-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	7-43	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	43-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
610: Calco-----	0-7	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	7-44	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28			
	44-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32			
770C2: Ves-----	0-16	18-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	16-20	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	20-28	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	28-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-5.0	0.37	0.37			
Terril-----	0-36	18-26	1.35-1.40	0.60-2.00	0.20-0.22	Low-----	3.0-5.0	0.24	0.24	5	6	48
	36-45	24-30	1.40-1.45	0.60-2.00	0.17-0.19	Low-----	2.0-3.0	0.28	0.28			
	45-60	15-30	1.45-1.70	0.60-2.00	0.16-0.18	Low-----	0.0-1.0	0.32	0.32			
810: Coriff-----	0-10	12-20	1.30-1.40	0.60-2.00	0.20-0.22	Low-----	6.0-10	0.28	0.28	5	4L	86
	10-24	10-18	1.35-1.45	2.00-6.00	0.12-0.15	Low-----	2.0-4.0	0.20	0.20			
	24-33	1-10	1.50-1.70	6.00-20.00	0.09-0.14	Low-----	1.0-2.0	0.20	0.20			
	33-60	18-35	1.50-1.70	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.37	0.37			
Fieldon-----	0-17	10-18	1.30-1.50	2.00-6.00	0.15-0.17	Low-----	4.0-7.0	0.20	0.20	4	3	86
	17-27	10-18	1.35-1.55	0.60-2.00	0.15-0.17	Low-----	2.0-6.0	0.20	0.20			
	27-60	5-15	1.40-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.20	0.20			
817: Canisteeo-----	0-20	27-35	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	20-31	25-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	31-38	25-35	1.30-1.50	0.60-2.00	0.12-0.18	Low-----	0.5-1.0	0.32	0.32			
	38-60	22-30	1.45-1.60	0.60-2.00	0.14-0.16	Low-----	0.0-0.5	0.32	0.32			
Seaforth-----	0-8	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L	86
	8-14	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28			
	14-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.28	0.28			
875C: Hawick-----	0-8	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low-----	1.0-3.0	0.10	0.15	5	8	---
	8-12	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15			
	12-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15			
Estherville-----	0-10	5-15	1.25-1.35	2.00-6.00	0.13-0.18	Low-----	2.0-4.0	0.20	0.20	3	3	86
	10-18	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low-----	0.0-0.5	0.20	0.20			
	18-60	0-8	1.50-1.65	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
887B: Clarion-----	0-16	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	0.24	5	6	48
	16-31	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.5-1.0	0.37	0.37			
	31-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.0-0.5	0.37	0.37			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
887B: Swanlake-----	0-8	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	8-14	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	14-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
899: Harps-----	0-13	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	3.0-5.0	0.24	0.24	5	4L	86
	13-17	24-35	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	1.0-3.0	0.32	0.32			
	17-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low-----	0.0-1.0	0.32	0.32			
Okoboji-----	0-8	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	8-28	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	28-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
920B: Clarion-----	0-14	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low-----	3.0-6.0	0.24	0.24	5	6	48
	14-26	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.5-1.0	0.37	0.37			
	26-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Low-----	0.0-0.5	0.37	0.37			
Storden-----	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	9-36	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	36-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Hawick-----	0-10	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low-----	1.0-3.0	0.10	0.15	5	8	---
	10-15	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15			
	15-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15			
927: Harps-----	0-18	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	3.0-5.0	0.24	0.24	5	4L	86
	18-33	24-35	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	1.0-3.0	0.32	0.32			
	33-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low-----	0.0-1.0	0.32	0.32			
Seaforth-----	0-13	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L	86
	13-24	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28			
	24-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.28	0.28			
Okoboji-----	0-9	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	9-41	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	41-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
954C2: Ves-----	0-10	18-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	10-22	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	22-38	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	38-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-5.0	0.37	0.37			
Storden-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	7-20	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	20-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
956: Canisteo-----	0-16	27-35	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	16-21	25-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	21-28	25-35	1.30-1.50	0.60-2.00	0.12-0.18	Low-----	0.5-1.0	0.32	0.32			
	28-60	22-30	1.45-1.60	0.60-2.00	0.14-0.16	Low-----	0.0-0.5	0.32	0.32			
Glencoe-----	0-10	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	6	48
	10-32	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	2.0-5.0	0.28	0.28			
	32-42	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			
	42-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low-----	0.0-3.0	0.28	0.28			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
960D2: Storden-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	7-18	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	18-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Omsrud-----	0-9	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	2.0-4.0	0.24	0.24	5	6	48
	9-36	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low-----	0.5-2.0	0.32	0.32			
	36-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.37	0.37			
960F: Storden-----	0-6	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	6-15	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	15-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Omsrud-----	0-9	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	2.0-4.0	0.24	0.24	5	6	48
	9-16	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low-----	0.5-2.0	0.32	0.32			
	16-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.37	0.37			
978: Cordova-----	0-22	27-30	1.25-1.45	0.20-0.60	0.18-0.22	Moderate	4.0-7.0	0.28	0.28	5	6	48
	22-39	28-35	1.35-1.50	0.20-0.60	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			
	39-60	18-30	1.45-1.70	0.60-2.00	0.14-0.16	Moderate	0.0-1.0	0.28	0.28			
Rolfe-----	0-21	22-27	1.35-1.40	0.60-2.00	0.22-0.24	Low-----	3.0-5.0	0.37	0.37	5	6	48
	21-40	38-45	1.40-1.50	0.06-0.20	0.11-0.13	High-----	1.0-2.0	0.28	0.28			
	40-60	24-35	1.50-1.60	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.28	0.28			
999C2: Ves-----	0-8	18-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	8-25	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	25-40	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	40-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-5.0	0.37	0.37			
Storden-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	7-32	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	32-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Hawick-----	0-7	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low-----	1.0-3.0	0.10	0.15	5	8	---
	7-15	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15			
	15-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15			
1030: Pits. Udipsamments---	0-14	1-15	1.50-1.70	2.00-20.00	0.05-0.10	Low-----	0.0-0.5	0.15	0.15	5	2	220
	14-60	1-10	1.50-1.70	6.00-20.00	0.05-0.08	Low-----	---	0.10	0.10			
	60-80	1-10	1.50-1.70	>20.00	0.03-0.05	Low-----	---	0.05	0.10			
1080: Klossner-----	0-32	---	0.25-0.45	0.20-6.00	0.35-0.45	-----	25-60	---	---	2	8	---
	32-60	20-35	1.45-1.70	0.20-2.00	0.14-0.22	Moderate	5.0-20	0.28	0.28			
Okoboji-----	0-17	30-40	1.20-1.25	0.60-2.00	0.22-0.25	Moderate	10-18	0.32	0.32	5	6	48
	17-48	35-45	1.35-1.40	0.20-0.60	0.18-0.20	High-----	---	0.37	0.37			
	48-60	35-45	1.35-1.40	0.20-0.60	0.18-0.20	High-----	---	0.37	0.37			
Glencoe-----	0-26	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	8	---
	26-30	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	2.0-6.0	0.28	0.28			
	30-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low-----	0.0-3.0	0.28	0.28			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
1100: Niccollet-----	0-15	27-35	1.15-1.25	0.60-2.00	0.17-0.22	Moderate	4.0-8.0	0.24	0.24	5	7	38
	15-20	25-35	1.25-1.35	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.32	0.32			
	20-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Low-----	0.0-1.0	0.32	0.32			
1101: Webster-----	0-17	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	4.0-7.0	0.28	0.28	5	7	38
	17-24	25-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	2.0-4.0	0.32	0.32			
	24-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Moderate	1.0-2.0	0.32	0.32			
1159B: Strout-----	0-10	35-45	1.30-1.50	0.20-0.60	0.14-0.19	High-----	3.0-6.0	0.28	0.28	5	4	86
	10-23	35-50	1.40-1.70	0.20-0.60	0.12-0.18	High-----	0.5-2.0	0.24	0.24			
	23-60	30-45	1.60-1.80	0.06-0.60	0.10-0.15	High-----	0.0-1.0	0.37	0.37			
Arkton-----	0-9	30-40	1.30-1.60	0.20-0.60	0.15-0.19	Moderate	2.0-5.0	0.24	0.24	5	6	48
	9-25	30-45	1.40-1.70	0.20-0.60	0.10-0.19	High-----	0.0-2.0	0.28	0.28			
	25-60	25-40	1.60-1.80	0.06-0.60	0.13-0.19	Moderate	0.0-1.0	0.37	0.37			
1162A: Kandiyohi-----	0-9	40-50	1.30-1.50	0.06-0.60	0.16-0.22	High-----	4.0-7.0	0.28	0.28	5	4	86
	9-21	35-60	1.40-1.60	0.06-0.60	0.14-0.19	High-----	0.5-2.0	0.32	0.32			
	21-46	30-55	1.50-1.70	0.06-0.20	0.13-0.19	High-----	0.0-1.0	0.37	0.37			
	46-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High-----	0.0-1.0	0.37	0.37			
1169: Corvuso-----	0-11	35-55	1.30-1.45	0.06-0.60	0.14-0.22	High-----	4.0-7.0	0.24	0.24	5	4L	86
	11-28	35-60	1.40-1.60	0.06-0.60	0.13-0.19	High-----	0.0-1.0	0.32	0.32			
	28-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High-----	0.0-0.5	0.37	0.37			
Lura-----	0-9	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	4.0-12	0.28	0.28	5	4	86
	9-43	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	1.0-4.0	0.32	0.32			
	43-60	28-60	1.30-1.45	0.06-0.60	0.11-0.19	High-----	0.0-1.0	0.32	0.32			
1193: Cosmos-----	0-23	35-50	1.40-1.50	0.06-0.20	0.16-0.22	High-----	4.0-8.0	0.28	0.28	5	4	86
	23-38	35-60	1.40-1.60	0.06-0.20	0.14-0.19	High-----	0.5-2.0	0.32	0.32			
	38-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	Moderate	0.0-0.5	0.32	0.32			
1205: Leen-----	0-9	27-35	1.25-1.50	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	9-27	18-35	1.25-1.50	0.60-2.00	0.18-0.24	Moderate	1.0-3.0	0.43	0.43			
	27-36	18-27	1.25-1.45	0.60-2.00	0.20-0.24	Low-----	1.0-2.0	0.43	0.43			
	36-60	18-32	1.30-1.55	0.60-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
Okoboji-----	0-32	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	32-38	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	38-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
1242F: Swanlake-----	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	9-15	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	15-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
Terril-----	0-32	18-26	1.35-1.40	0.60-2.00	0.20-0.22	Low-----	3.0-5.0	0.24	0.24	5	6	48
	32-40	24-30	1.40-1.45	0.60-2.00	0.17-0.19	Low-----	2.0-3.0	0.28	0.28			
	40-60	15-30	1.45-1.70	0.60-2.00	0.16-0.18	Low-----	0.0-1.0	0.32	0.32			
1261B: Bechyn-----	0-15	10-27	1.30-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-5.0	0.28	0.28	1	6	48
	15-18	10-27	1.30-1.60	0.60-2.00	0.14-0.22	Low-----	0.5-1.0	0.28	0.28			
	18-60	---	---	0.00-20.00	---	-----	0.0-0.5	---	---			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
1262: Seaforth-----	0-16	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L	86
	16-44	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28			
	44-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.28	0.28			
1267: Cedarrock-----	0-28	27-40	1.35-1.45	0.20-0.60	0.18-0.21	High-----	4.0-12	0.28	0.28	2	4L	86
	28-34	18-35	1.40-1.60	0.20-0.60	0.16-0.19	Moderate	1.0-3.0	0.32	0.32			
	34-60	---	---	0.00-20.00	---	-----	---	---	---			
1268: Hanlon-----	0-14	15-25	1.30-1.35	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	6	48
	14-48	12-18	1.45-1.55	2.00-6.00	0.16-0.18	Low-----	1.0-2.0	0.20	0.20			
	48-60	5-10	1.55-1.70	2.00-6.00	0.11-0.13	Low-----	1.0-2.0	0.20	0.20			
1269: Lowlein-----	0-15	12-20	1.20-1.40	0.60-2.00	0.20-0.22	Low-----	4.0-7.0	0.28	0.28	5	5	56
	15-32	10-18	1.35-1.45	2.00-6.00	0.12-0.14	Low-----	1.0-2.0	0.24	0.24			
	32-60	18-32	1.50-1.70	0.60-2.00	0.17-0.19	Low-----	0.0-0.5	0.37	0.37			
1270D: Bechyn-----	0-9	10-27	1.30-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-5.0	0.28	0.28	1	6	48
	9-15	10-27	1.30-1.60	0.60-2.00	0.14-0.22	Low-----	0.5-1.0	0.28	0.28			
	15-60	---	---	0.00-20.00	---	-----	0.0-0.5	---	---			
Rock outcrop----	0-60	---	---	0.00-20.00	---	-----	---	---	---	---	8	---
1285: Chetomba-----	0-23	27-35	1.20-1.30	0.60-2.00	0.18-0.24	Moderate	4.0-8.0	0.28	0.28	5	7	38
	23-31	18-35	1.25-1.35	0.60-2.00	0.16-0.22	Moderate	1.0-2.0	0.28	0.28			
	31-43	18-35	1.25-1.40	0.60-2.00	0.16-0.22	Low-----	0.5-1.0	0.37	0.37			
	43-60	22-32	1.35-1.55	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.37	0.37			
1286: Prinsburg-----	0-19	27-35	1.20-1.30	0.60-2.00	0.18-0.24	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	19-36	18-35	1.25-1.35	0.60-2.00	0.16-0.22	Moderate	1.0-2.0	0.37	0.37			
	36-46	18-35	1.25-1.40	0.60-2.00	0.16-0.22	Low-----	0.5-1.0	0.37	0.37			
	46-60	22-32	1.35-1.55	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.28	0.28			
1287: Calco-----	0-7	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	7-41	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28			
	41-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32			
1355B: Amiret-----	0-10	18-32	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	10-26	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	26-35	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	35-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Swanlake-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	7-32	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	32-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
1356: Water.												
1369A: Crooksford-----	0-15	18-27	1.25-1.50	0.60-2.00	0.20-0.24	Moderate	4.0-6.0	0.28	0.28	5	6	48
	15-29	18-30	1.25-1.50	0.60-2.00	0.18-0.24	Moderate	1.0-2.0	0.43	0.43			
	29-36	18-27	1.25-1.55	0.60-2.00	0.17-0.24	Moderate	0.5-1.0	0.43	0.43			
	36-60	18-30	1.30-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
1369B:												
Crooksford-----	0-15	18-27	1.25-1.50	0.60-2.00	0.20-0.24	Moderate	4.0-6.0	0.28	0.28	5	6	48
	15-27	18-30	1.25-1.50	0.60-2.00	0.18-0.24	Moderate	1.0-2.0	0.43	0.43			
	27-43	18-27	1.25-1.55	0.60-2.00	0.17-0.24	Moderate	0.5-1.0	0.43	0.43			
	43-60	18-30	1.30-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
1370B:												
Amiret-----	0-12	18-32	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	12-20	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	20-30	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	30-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
1371B:												
Crooksford-----	0-10	18-27	1.25-1.50	0.60-2.00	0.20-0.24	Moderate	4.0-6.0	0.28	0.28	5	6	48
	10-25	18-30	1.25-1.50	0.60-2.00	0.18-0.24	Moderate	1.0-2.0	0.43	0.43			
	25-35	18-27	1.25-1.55	0.60-2.00	0.17-0.24	Moderate	0.5-1.0	0.43	0.43			
	35-60	18-30	1.30-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Swanlake-----	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	9-46	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	46-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
1373C:												
Omsrud-----	0-7	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	2.0-4.0	0.24	0.24	5	6	48
	7-22	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low-----	0.5-2.0	0.32	0.32			
	22-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.37	0.37			
Storden-----	0-10	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	10-23	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	23-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Hawick-----	0-9	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low-----	1.0-3.0	0.10	0.15	5	8	---
	9-28	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15			
	28-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15			
1374:												
Havelock-----	0-23	27-35	1.40-1.50	0.60-2.00	0.20-0.22	High-----	5.0-7.0	0.24	0.24	5	4L	86
	23-35	27-35	1.40-1.50	0.60-2.00	0.20-0.22	High-----	1.0-2.0	0.28	0.28			
	35-60	12-26	1.50-1.65	2.00-6.00	0.13-0.17	Low-----	0.0-0.5	0.28	0.28			
1375D:												
Storden-----	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	9-24	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	24-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Ves-----	0-8	18-30	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	8-22	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	22-44	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	44-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-5.0	0.37	0.37			
1376C:												
Omsrud-----	0-10	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	2.0-4.0	0.24	0.24	5	6	48
	10-29	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low-----	0.5-2.0	0.32	0.32			
	29-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low-----	0.0-1.0	0.37	0.37			
Storden-----	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low-----	1.0-2.0	0.28	0.28	5	4L	86
	7-55	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	55-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
1382: Louris-----	0-13	18-27	1.25-1.50	0.60-2.00	0.20-0.24	Low-----	4.0-7.0	0.28	0.28	5	4L	86
	13-20	18-35	1.25-1.50	0.60-2.00	0.18-0.22	Moderate	1.0-2.0	0.43	0.43			
	20-31	18-27	1.25-1.45	0.60-2.00	0.20-0.24	Low-----	0.5-1.0	0.43	0.43			
	31-60	18-32	1.30-1.55	0.60-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
1386B: Amiret-----	0-12	18-32	1.35-1.45	0.60-2.00	0.17-0.22	Moderate	2.0-6.0	0.24	0.24	5	6	48
	12-20	18-32	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.32	0.32			
	20-50	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	50-60	18-32	1.35-1.55	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Swanlake-----	0-8	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.28	0.28	5	4L	86
	8-15	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	15-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
Hawick-----	0-8	5-15	1.35-1.55	2.00-6.00	0.13-0.15	Low-----	1.0-4.0	0.17	0.17	3	3	86
	8-13	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low-----	0.0-0.5	0.10	0.15			
	13-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low-----	0.0-0.5	0.10	0.15			
1388B: Terril-----	0-27	18-26	1.35-1.40	0.60-2.00	0.20-0.22	Low-----	3.0-5.0	0.24	0.24	5	6	48
	27-40	24-30	1.40-1.45	0.60-2.00	0.17-0.19	Low-----	2.0-3.0	0.28	0.28			
	40-60	22-30	1.45-1.70	0.60-2.00	0.16-0.18	Low-----	0.0-1.0	0.32	0.32			
1389: Havelock-----	0-30	10-26	1.40-1.45	0.60-2.00	0.20-0.22	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	30-40	27-35	1.40-1.50	0.60-2.00	0.20-0.22	High-----	1.0-2.0	0.28	0.28			
	40-60	12-26	1.50-1.65	2.00-6.00	0.13-0.17	Low-----	0.0-0.5	0.28	0.28			
1390: Leen-----	0-15	27-35	1.25-1.50	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	15-25	18-35	1.25-1.50	0.60-2.00	0.18-0.24	Moderate	1.0-3.0	0.43	0.43			
	25-38	18-27	1.25-1.45	0.60-2.00	0.20-0.24	Low-----	1.0-2.0	0.43	0.43			
	38-60	18-32	1.30-1.55	0.60-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
1392B: Grogan-----	0-15	8-18	1.25-1.40	2.00-6.00	0.22-0.24	Low-----	2.0-4.0	0.32	0.32	5	5	56
	15-38	8-18	1.40-1.50	2.00-6.00	0.17-0.19	Low-----	1.0-2.0	0.43	0.43			
	38-60	5-15	1.50-1.60	2.00-6.00	0.17-0.19	Low-----	0.0-1.0	0.43	0.43			
1802: Calcousta-----	0-12	27-35	1.25-1.30	0.60-2.00	0.21-0.23	High-----	8.0-10	0.28	0.28	5	4L	86
	12-24	24-32	1.30-1.40	0.60-2.00	0.18-0.20	High-----	2.0-3.0	0.43	0.43			
	24-60	22-30	1.30-1.40	0.60-2.00	0.20-0.22	Moderate	0.0-1.0	0.43	0.43			
Okoboji-----	0-6	20-30	1.20-1.25	0.60-2.00	0.22-0.25	Moderate	10-18	0.32	0.32	5	6	48
	6-32	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	32-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
1833: Coland-----	0-18	27-35	1.40-1.50	0.60-2.00	0.20-0.22	Moderate	5.0-7.0	0.24	0.24	5	6	48
	18-54	27-35	1.40-1.50	0.60-2.00	0.20-0.22	Moderate	3.0-5.0	0.24	0.24			
	54-60	12-26	1.50-1.65	0.60-6.00	0.13-0.17	Low-----	0.0-2.0	0.28	0.28			
1834: Coland-----	0-12	27-35	1.40-1.50	0.60-2.00	0.20-0.22	Moderate	5.0-7.0	0.24	0.24	5	6	48
	12-28	27-35	1.40-1.50	0.60-2.00	0.20-0.22	Moderate	3.0-5.0	0.24	0.24			
	28-60	12-26	1.50-1.65	0.60-6.00	0.13-0.17	Low-----	0.0-2.0	0.28	0.28			

PHYSICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	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/hr	In/in		Pct					
1845A: Estherville-----	0-12	10-18	1.35-1.45	2.00-6.00	0.19-0.22	Low-----	2.0-4.0	0.20	0.20	3	5	56
	12-17	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low-----	0.0-0.5	0.20	0.20			
	17-60	0-8	1.50-1.65	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
1845B: Estherville-----	0-8	10-18	1.35-1.45	2.00-6.00	0.19-0.22	Low-----	2.0-4.0	0.20	0.20	3	5	56
	8-13	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low-----	0.0-0.5	0.20	0.20			
	13-60	0-8	1.50-1.65	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
1900: Okoboji-----	0-12	20-30	1.20-1.25	0.60-2.00	0.22-0.25	Moderate	10-18	0.32	0.32	5	6	48
	12-30	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	30-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
Canisteeo-----	0-19	27-32	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	19-23	20-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	23-39	10-35	1.30-1.50	0.60-2.00	0.12-0.18	Low-----	0.5-1.0	0.32	0.32			
	39-60	22-32	1.45-1.60	0.60-2.00	0.14-0.16	Low-----	0.0-0.5	0.32	0.32			
1917: Nishna-----	0-21	36-40	1.30-1.35	0.06-0.20	0.12-0.14	High-----	6.0-10	0.37	0.37	5	4	86
	21-60	38-46	1.35-1.40	0.06-0.20	0.11-0.13	High-----	0.0-2.0	0.28	0.28			
1958: Danube-----	0-19	40-46	1.25-1.40	0.20-0.60	0.14-0.17	Moderate	4.0-8.0	0.28	0.28	4	4	86
	19-31	12-30	1.30-1.40	0.60-2.00	0.20-0.22	Moderate	0.5-1.0	0.37	0.37			
	31-35	8-12	1.45-1.55	2.00-6.00	0.12-0.16	Low-----	0.0-0.5	0.24	0.20			
	35-60	1-8	1.55-1.65	6.00-20.00	0.02-0.08	Low-----	0.0-0.5	0.15	0.10			
1999: Minneiska-----	0-7	10-27	1.30-1.40	2.00-6.00	0.20-0.22	Low-----	2.0-5.0	0.28	0.28	5	4L	86
	7-60	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	1.0-2.0	0.28	0.28			
Rushriver-----	0-46	10-22	1.35-1.50	0.60-2.00	0.17-0.22	Low-----	1.0-4.0	0.32	0.32	5	4L	86
	46-60	2-10	1.55-1.65	2.00-20.00	0.06-0.15	Low-----	0.5-2.0	0.17	0.17			

CHEMICAL PROPERTIES OF THE SOILS

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
27A: Dickinson-----	0-17	10-18	15.0-20.0	5.6-7.3	---	---	---
	17-32	10-15	15.0-20.0	5.1-6.5	---	---	---
	32-38	4-10	5.0-10.0	5.1-6.5	---	---	---
	38-60	4-10	5.0-10.0	5.6-7.3	---	---	---
27B: Dickinson-----	0-15	10-18	15.0-20.0	5.6-7.3	---	---	---
	15-29	10-15	15.0-20.0	5.1-6.5	---	---	---
	29-60	4-10	5.0-10.0	5.6-7.3	---	---	---
35: Blue Earth-----	0-22	18-32	30.0-70.0	7.4-8.4	5-20	---	---
	22-60	18-32	30.0-70.0	7.4-8.4	5-40	---	---
39A: Wadena-----	0-18	18-27	5.0-25.0	6.1-7.3	---	---	---
	18-37	18-30	5.0-20.0	5.6-7.3	---	---	---
	37-60	1-5	0.0-5.0	6.6-8.4	0-15	---	---
39B: Wadena-----	0-14	18-27	5.0-25.0	6.1-7.3	---	---	---
	14-30	18-30	5.0-20.0	5.6-7.3	---	---	---
	30-60	1-5	0.0-5.0	6.6-8.4	0-15	---	---
85: Calco-----	0-14	28-33	36.0-41.0	7.4-8.4	5-30	---	---
	14-40	30-35	36.0-41.0	7.4-8.4	5-30	---	---
	40-60	22-32	36.0-41.0	7.4-8.4	5-30	---	---
86: Canisteo-----	0-20	27-35	19.0-37.0	7.4-8.4	5-15	---	---
	20-23	25-35	12.0-29.0	7.4-8.4	12-18	---	---
	23-38	25-35	6.0-23.0	7.4-8.4	10-15	---	---
	38-60	22-30	9.0-20.0	7.4-8.4	10-15	---	---
94C: Terril-----	0-23	18-26	20.0-25.0	6.1-7.3	---	---	---
	23-50	24-30	20.0-25.0	6.1-7.3	---	---	---
	50-60	15-30	15.0-25.0	6.1-7.8	0-15	---	---
102B: Clarion-----	0-13	20-27	20.0-25.0	5.6-7.3	---	---	---
	13-25	23-30	20.0-25.0	5.6-7.8	0-15	---	---
	25-60	22-30	20.0-25.0	7.4-8.4	5-30	---	---
112: Harps-----	0-13	27-35	20.0-30.0	7.9-8.4	20-40	---	---
	13-30	24-35	15.0-25.0	7.9-8.4	20-30	---	---
	30-60	22-30	10.0-20.0	7.4-8.4	20-30	---	---
113: Webster-----	0-16	26-35	22.0-32.0	6.6-7.3	---	---	---
	16-32	25-35	15.0-25.0	6.6-7.8	0-10	---	---
	32-60	22-30	13.0-20.0	7.4-8.4	5-30	---	---
118: Crippin-----	0-10	22-27	20.0-25.0	6.6-8.4	0-25	---	---
	10-26	24-30	20.0-25.0	7.4-8.4	5-30	---	---
	26-60	22-30	20.0-25.0	7.9-8.4	15-30	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
128C2: Grogan-----	0-13	8-18	10.0-20.0	5.6-7.3	---	---	---
	13-35	8-18	5.0-15.0	6.1-7.8	0-5	---	---
	35-60	5-15	3.0-13.0	7.4-8.4	5-15	---	---
130: Nicollet-----	0-16	27-35	25.0-40.0	5.6-7.3	---	---	---
	16-35	25-35	15.0-25.0	5.6-7.8	0-15	---	---
	35-60	22-30	10.0-20.0	7.4-8.4	5-30	---	---
134: Okoboji-----	0-8	35-42	41.0-45.0	6.1-7.8	0-15	---	---
	8-28	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	28-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
156: Fairhaven-----	0-18	18-27	20.0-30.0	5.6-7.3	---	---	---
	18-33	18-30	15.0-25.0	5.6-7.3	---	---	---
	33-60	0-5	0.0-5.0	6.1-8.4	0-15	---	---
211: Lura-----	0-8	45-60	35.0-70.0	6.1-7.8	0-5	---	---
	8-39	45-60	29.0-54.0	6.1-7.3	---	---	---
	39-60	28-60	17.0-47.0	6.6-7.8	10-20	---	---
227: Lemond-----	0-12	6-18	10.0-25.0	7.4-8.4	5-20	0-2	---
	12-34	6-18	5.0-15.0	7.4-8.4	10-25	0-5	---
	34-60	1-10	1.0-10.0	7.4-8.4	10-25	0-5	---
247: Linder-----	0-18	14-18	15.0-20.0	5.6-7.8	0-15	---	---
	18-30	10-18	10.0-15.0	6.1-7.8	0-15	---	---
	30-60	2-8	5.0-10.0	7.4-8.4	5-30	---	---
255: Mayer-----	0-21	18-30	15.0-31.0	7.4-8.4	5-30	---	---
	21-37	18-30	13.0-27.0	7.4-8.4	5-30	---	---
	37-60	1-5	1.0-10.0	7.4-8.4	5-30	---	---
282: Hanska-----	0-17	6-18	11.0-25.0	6.1-7.8	---	---	---
	17-26	6-18	7.0-17.0	6.1-7.3	---	---	---
	26-31	2-10	2.0-9.0	6.1-7.8	0-10	---	---
	31-60	1-10	1.0-6.0	6.6-7.8	5-10	---	---
318: Mayer-----	0-23	18-30	---	7.4-8.4	5-30	---	---
	23-33	18-30	---	7.4-8.4	5-30	---	---
	33-60	1-5	---	7.4-8.4	5-30	---	---
327A: Dickman-----	0-14	6-18	5.0-15.0	5.6-6.5	---	---	---
	14-20	6-18	3.0-10.0	5.6-7.3	---	---	---
	20-60	1-10	0.0-5.0	5.6-7.8	0-5	---	---
327B: Dickman-----	0-11	6-18	5.0-15.0	5.6-6.5	---	---	---
	11-20	6-18	3.0-10.0	5.6-7.3	---	---	---
	20-60	1-10	0.0-5.0	5.6-7.8	0-5	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
327C: Dickman-----	0-8	6-18	5.0-15.0	5.6-6.5	---	---	---
	8-16	6-18	3.0-10.0	5.6-7.3	---	---	---
	16-60	1-10	0.0-5.0	5.6-7.8	0-5	---	---
336: Delft-----	0-19	24-27	---	5.6-7.8	---	---	---
	19-30	18-35	---	5.6-7.8	---	---	---
	30-49	18-32	---	6.6-7.8	---	---	---
	49-60	15-32	---	7.4-8.4	---	---	---
386: Okoboji-----	0-13	20-30	41.0-50.0	6.1-7.8	0-15	---	---
	13-35	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	35-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
392: Biscay-----	0-17	18-30	20.0-35.0	6.1-7.8	0-15	---	---
	17-24	18-30	12.0-25.0	6.6-7.8	0-15	---	---
	24-60	1-6	1.0-5.0	7.4-8.4	5-30	---	---
423: Seaforth-----	0-8	20-30	16.0-27.0	7.4-8.4	5-20	---	---
	8-23	20-30	10.0-19.0	7.4-8.4	18-30	---	---
	23-60	20-27	10.0-18.0	7.4-8.4	10-25	---	---
446: Normania-----	0-14	18-27	17.0-32.0	6.1-7.3	---	---	---
	14-20	18-32	10.0-21.0	6.6-7.8	---	---	---
	20-29	18-32	9.0-20.0	7.4-8.4	15-25	---	---
	29-60	18-32	9.0-20.0	7.4-8.4	10-20	---	---
463A: Minneiska-----	0-9	10-27	10.0-30.0	7.4-8.4	10-20	---	---
	9-60	5-18	5.0-15.0	7.4-8.4	5-20	---	---
463B: Minneiska-----	0-10	10-27	10.0-30.0	7.4-8.4	10-20	---	---
	10-60	5-18	5.0-15.0	7.4-8.4	5-20	---	---
519: Klossner-----	0-22	---	150-200	7.4-8.4	5-30	---	---
	22-34	22-35	150-200	7.4-8.4	5-30	---	---
	34-47	18-32	20.0-50.0	7.4-8.4	5-30	---	---
	47-60	22-32	20.0-50.0	7.4-8.4	5-30	---	---
525: Muskego-----	0-10	---	140-180	5.6-7.3	---	---	---
	10-20	---	150-190	5.6-7.3	---	---	---
	20-60	18-35	10.0-45.0	6.6-8.4	60-80	---	---
539: Klossner-----	0-20	---	50-150	5.6-7.8	0-5	---	---
	20-29	22-35	35.0-65.0	6.1-7.8	0-5	---	---
	29-60	22-35	20.0-40.0	6.1-7.8	0-5	---	---
574: Du Page-----	0-9	18-27	17.0-26.0	6.6-8.4	0-10	---	---
	9-60	18-27	11.0-18.0	7.4-8.4	5-20	---	---
575: Nishna-----	0-9	40-44	41.0-45.0	7.4-8.4	5-30	---	0-2
	9-60	38-46	30.0-36.0	7.4-8.4	5-30	---	0-2

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
595F:							
Swanlake-----	0-7	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	7-43	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	43-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
610:							
Calco-----	0-7	28-33	36.0-41.0	7.4-8.4	5-30	---	---
	7-44	30-35	36.0-41.0	7.4-8.4	5-30	---	---
	44-60	22-32	36.0-41.0	7.4-8.4	5-30	---	---
770C2:							
Ves-----	0-16	18-30	14.0-27.0	6.1-7.8	---	---	---
	16-20	18-32	10.0-20.0	6.6-7.8	---	---	---
	20-28	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	28-60	18-32	---	7.4-8.4	10-20	---	---
Terril-----	0-36	18-26	20.0-25.0	6.1-7.3	---	---	---
	36-45	24-30	20.0-25.0	6.1-7.3	---	---	---
	45-60	15-30	15.0-25.0	6.1-7.8	0-15	---	---
810:							
Coriff-----	0-10	12-20	18.0-30.0	7.4-8.4	10-20	0-5	---
	10-24	10-18	10.0-17.0	7.4-8.4	5-20	0-5	---
	24-33	1-10	2.0-10.0	7.4-8.4	5-20	0-5	---
	33-60	18-35	10.0-20.0	7.4-8.4	5-15	0-5	---
Fieldon-----	0-17	10-18	10.0-25.0	7.4-8.4	5-30	---	---
	17-27	10-18	10.0-20.0	7.4-8.4	5-30	---	---
	27-60	5-15	1.0-10.0	7.4-8.4	5-30	---	---
817:							
Canisteo-----	0-20	27-35	19.0-37.0	7.4-8.4	5-15	---	---
	20-31	25-35	12.0-29.0	7.4-8.4	12-18	---	---
	31-38	25-35	6.0-23.0	7.4-8.4	10-15	---	---
	38-60	22-30	9.0-20.0	7.4-8.4	10-15	---	---
Seaforth-----	0-8	20-30	16.0-27.0	7.4-8.4	5-20	---	---
	8-14	20-30	10.0-19.0	7.4-8.4	18-30	---	---
	14-60	20-27	10.0-18.0	7.4-8.4	10-25	---	---
875C:							
Hawick-----	0-8	2-10	1.0-10.0	6.1-7.8	0-10	---	---
	8-12	1-10	1.0-5.0	6.1-7.8	0-10	---	---
	12-60	1-5	1.0-5.0	7.4-8.4	5-15	---	---
Estherville-----	0-10	5-15	2.0-20.0	5.6-7.3	---	---	---
	10-18	10-18	4.0-20.0	5.6-7.3	---	---	---
	18-60	0-8	0.0-5.0	6.6-8.4	0-15	---	---
887B:							
Clarion-----	0-16	20-27	20.0-25.0	5.6-7.3	---	---	---
	16-31	23-30	20.0-25.0	5.6-7.8	0-15	---	---
	31-60	22-30	20.0-25.0	7.4-8.4	5-30	---	---
Swanlake-----	0-8	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	8-14	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	14-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
899:							
Harps-----	0-13	27-35	20.0-30.0	7.9-8.4	20-40	---	---
	13-17	24-35	15.0-25.0	7.9-8.4	20-30	---	---
	17-60	22-30	10.0-20.0	7.4-8.4	20-30	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
899:							
Okoboji-----	0-8	35-42	41.0-45.0	6.1-7.8	0-15	---	---
	8-28	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	28-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
920B:							
Clarion-----	0-14	20-27	20.0-25.0	5.6-7.3	---	---	---
	14-26	23-30	20.0-25.0	5.6-7.8	0-15	---	---
	26-60	22-30	20.0-25.0	7.4-8.4	5-30	---	---
Storden-----	0-9	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	9-36	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	36-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Hawick-----	0-10	2-10	1.0-10.0	6.1-7.8	0-10	---	---
	10-15	1-10	1.0-5.0	6.1-7.8	0-10	---	---
	15-60	1-5	1.0-5.0	7.4-8.4	5-15	---	---
927:							
Harps-----	0-18	27-35	20.0-30.0	7.9-8.4	20-40	---	---
	18-33	24-35	15.0-25.0	7.9-8.4	20-30	---	---
	33-60	22-30	10.0-20.0	7.4-8.4	20-30	---	---
Seaforth-----	0-13	20-30	16.0-27.0	7.4-8.4	5-20	---	---
	13-24	20-30	10.0-19.0	7.4-8.4	18-30	---	---
	24-60	20-27	10.0-18.0	7.4-8.4	10-25	---	---
Okoboji-----	0-9	35-42	41.0-45.0	6.1-7.8	0-15	---	---
	9-41	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	41-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
954C2:							
Ves-----	0-10	18-30	14.0-27.0	6.1-7.8	---	---	---
	10-22	18-32	10.0-20.0	6.6-7.8	---	---	---
	22-38	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	38-60	18-32	---	7.4-8.4	10-20	---	---
Storden-----	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	7-20	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	20-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
956:							
Canisteo-----	0-16	27-35	19.0-37.0	7.4-8.4	5-15	---	---
	16-21	25-35	12.0-29.0	7.4-8.4	12-18	---	---
	21-28	25-35	6.0-23.0	7.4-8.4	10-15	---	---
	28-60	22-30	9.0-20.0	7.4-8.4	10-15	---	---
Glencoe-----	0-10	27-35	23.0-37.0	6.1-7.8	0-5	---	---
	10-32	25-35	16.0-27.0	6.1-7.8	0-5	---	---
	32-42	25-35	14.0-25.0	6.6-7.8	0-5	---	---
	42-60	22-32	11.0-22.0	6.6-7.8	0-20	---	---
960D2:							
Storden-----	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	7-18	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	18-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Omsrud-----	0-9	20-26	14.0-35.0	5.6-7.3	---	---	---
	9-36	22-30	9.0-22.0	5.6-7.3	---	---	---
	36-60	22-30	7.0-16.0	7.4-8.4	5-30	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
960F:							
Storden-----	0-6	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	6-15	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	15-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Omsrud-----	0-9	20-26	14.0-35.0	5.6-7.3	---	---	---
	9-16	22-30	9.0-22.0	5.6-7.3	---	---	---
	16-60	22-30	7.0-16.0	7.4-8.4	5-30	---	---
978:							
Cordova-----	0-22	27-30	20.0-30.0	6.1-7.3	---	---	---
	22-39	28-35	15.0-25.0	5.1-6.5	---	---	---
	39-60	18-30	10.0-17.0	7.4-8.4	5-20	---	---
Rolfe-----	0-21	22-27	20.0-25.0	5.1-7.3	---	---	---
	21-40	38-45	20.0-30.0	6.1-7.3	---	---	---
	40-60	24-35	20.0-25.0	6.1-8.4	0-25	---	---
999C2:							
Ves-----	0-8	18-30	14.0-27.0	6.1-7.8	---	---	---
	8-25	18-32	10.0-20.0	6.6-7.8	---	---	---
	25-40	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	40-60	18-32	---	7.4-8.4	10-20	---	---
Storden-----	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	7-32	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	32-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Hawick-----	0-7	2-10	1.0-10.0	6.1-7.8	0-10	---	---
	7-15	1-10	1.0-5.0	6.1-7.8	0-10	---	---
	15-60	1-5	1.0-5.0	7.4-8.4	5-15	---	---
1030:							
Pits.							
Udipsamments---	0-14	1-15	1.0-5.0	6.6-7.3	---	---	---
	14-60	1-10	1.0-3.0	6.6-7.3	---	---	---
	60-80	1-10	1.0-3.0	7.4-8.4	0-5	---	---
1080:							
Klossner-----	0-32	---	50-150	5.1-7.8	0-5	---	---
	32-60	20-35	20.0-60.0	6.1-8.4	0-20	---	---
Okoboji-----	0-17	30-40	41.0-50.0	6.1-7.8	0-15	---	---
	17-48	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	48-60	35-45	36.0-41.0	6.6-7.8	0-30	---	---
Glencoe-----	0-26	27-35	20.0-40.0	6.1-7.8	0-5	---	---
	26-30	25-35	15.0-30.0	6.6-7.8	0-5	---	---
	30-60	22-32	10.0-20.0	7.4-7.8	5-20	---	---
1100:							
Nicollet-----	0-15	27-35	25.0-40.0	5.6-7.3	---	---	---
	15-20	25-35	15.0-25.0	5.6-7.8	0-15	---	---
	20-60	22-30	10.0-20.0	7.4-8.4	5-30	---	---
1101:							
Webster-----	0-17	27-35	22.0-32.0	6.6-7.3	---	---	---
	17-24	25-35	15.0-25.0	6.6-7.8	0-10	---	---
	24-60	22-30	13.0-20.0	7.4-8.4	5-30	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
1159B: Strout-----	0-10	35-45	25.0-45.0	6.1-7.3	---	---	---
	10-23	35-50	20.0-40.0	5.6-7.3	---	---	---
	23-60	30-45	15.0-35.0	7.4-8.4	5-30	---	---
Arkton-----	0-9	30-40	25.0-40.0	6.6-8.4	0-30	---	---
	9-25	30-45	20.0-35.0	7.4-8.4	15-30	---	---
	25-60	25-40	10.0-30.0	7.4-8.4	5-30	---	---
1162A: Kandiyohi-----	0-9	40-50	35.0-50.0	6.1-7.3	---	---	---
	9-21	35-60	25.0-45.0	6.1-7.3	---	---	---
	21-46	30-55	20.0-40.0	7.4-8.4	15-30	0-1	---
	46-60	30-55	20.0-40.0	7.4-8.4	10-20	0-1	---
1169: Corvuso-----	0-11	35-55	25.0-40.0	7.4-8.4	3-20	---	---
	11-28	35-60	15.0-30.0	7.4-8.4	15-25	0-2	---
	28-60	30-55	15.0-30.0	7.4-8.4	10-20	---	---
Lura-----	0-9	45-60	35.0-70.0	6.1-7.8	0-5	---	---
	9-43	45-60	29.0-54.0	6.1-7.3	---	---	---
	43-60	28-60	17.0-47.0	6.6-7.8	10-20	---	---
1193: Cosmos-----	0-23	35-50	30.0-50.0	6.1-7.3	---	---	---
	23-38	35-60	25.0-45.0	6.1-7.3	---	0-2	---
	38-60	30-55	15.0-30.0	7.4-8.4	10-20	0-2	---
1205: Leen-----	0-9	27-35	27.0-40.0	7.4-8.4	10-25	0-1	---
	9-27	18-35	15.0-30.0	7.9-8.4	20-35	0-1	---
	27-36	18-27	12.0-20.0	7.4-8.4	10-20	0-3	---
	36-60	18-32	13.0-24.0	7.4-8.4	10-20	0-3	---
Okoboji-----	0-32	35-42	41.0-45.0	6.1-7.8	0-15	---	---
	32-38	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	38-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
1242F: Swanlake-----	0-9	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	9-15	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	15-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
Terril-----	0-32	18-26	20.0-25.0	6.1-7.3	---	---	---
	32-40	24-30	20.0-25.0	6.1-7.3	---	---	---
	40-60	15-30	15.0-25.0	6.1-7.8	0-15	---	---
1261B: Bechyn-----	0-15	10-27	10.0-25.0	5.6-7.3	---	---	---
	15-18	10-27	5.0-15.0	5.6-7.8	0-5	---	---
	18-60	---	---	---	---	---	---
1262: Seaforth-----	0-16	20-30	16.0-27.0	7.4-8.4	5-20	---	---
	16-44	20-30	10.0-19.0	7.4-8.4	18-30	---	---
	44-60	20-27	10.0-18.0	7.4-8.4	10-25	---	---
1267: Cedarrock-----	0-28	27-40	30.0-45.0	7.4-8.4	5-25	---	---
	28-34	18-35	15.0-30.0	7.4-8.4	5-25	---	---
	34-60	---	---	---	---	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
1268:							
Hanlon-----	0-14	15-25	15.0-20.0	6.1-7.3	---	---	---
	14-48	12-18	10.0-15.0	6.1-7.3	---	---	---
	48-60	5-10	5.0-10.0	5.6-7.3	---	---	---
1269:							
Lowlein-----	0-15	12-20	15.0-25.0	6.1-7.3	---	---	---
	15-32	10-18	5.0-15.0	6.1-7.3	---	---	---
	32-60	18-32	10.0-20.0	7.4-8.4	5-20	---	---
1270D:							
Bechyn-----	0-9	10-27	10.0-25.0	5.6-7.3	---	---	---
	9-15	10-27	5.0-15.0	5.6-7.8	0-5	---	---
	15-60	---	---	---	---	---	---
Rock outcrop---	0-60	---	---	---	---	---	---
1285:							
Chetomba-----	0-23	27-35	22.0-35.0	6.1-7.3	---	---	---
	23-31	18-35	14.0-28.0	6.6-7.8	---	---	---
	31-43	18-35	10.0-20.0	7.4-8.4	5-20	---	---
	43-60	22-32	10.0-20.0	7.4-8.4	5-20	---	---
1286:							
Prinsburg-----	0-19	27-35	22.0-35.0	7.4-8.4	5-25	---	---
	19-36	18-35	14.0-28.0	7.4-8.4	5-25	---	---
	36-46	18-35	10.0-20.0	7.4-8.4	5-25	---	---
	46-60	22-32	10.0-20.0	7.4-8.4	5-20	---	---
1287:							
Calco-----	0-7	28-33	36.0-41.0	7.4-8.4	5-30	---	---
	7-41	30-35	36.0-41.0	7.4-8.4	5-30	---	---
	41-60	22-32	36.0-41.0	7.4-8.4	5-30	---	---
1355B:							
Amiret-----	0-10	18-32	14.0-27.0	6.1-7.3	---	---	---
	10-26	18-32	10.0-20.0	6.1-7.3	---	---	---
	26-35	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	35-60	18-32	10.0-18.0	7.4-8.4	10-20	---	---
Swanlake-----	0-7	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	7-32	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	32-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
1356:							
Water.							
1369A:							
Crooksford-----	0-15	18-27	15.0-32.0	6.1-7.3	---	---	---
	15-29	18-30	8.0-20.0	6.6-7.8	0-10	---	---
	29-36	18-27	8.0-20.0	7.4-8.4	15-25	---	---
	36-60	18-30	7.0-18.0	7.4-8.4	10-20	---	---
1369B:							
Crooksford-----	0-15	18-27	15.0-32.0	6.1-7.3	---	---	---
	15-27	18-30	8.0-20.0	6.6-7.8	0-10	---	---
	27-43	18-27	8.0-20.0	7.4-8.4	15-25	---	---
	43-60	18-30	7.0-18.0	7.4-8.4	10-20	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
1370B:							
Amiret -----	0-12	18-32	14.0-27.0	6.1-7.3	---	---	---
	12-20	18-32	10.0-20.0	6.1-7.3	---	---	---
	20-30	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	30-60	18-32	10.0-18.0	7.4-8.4	10-20	---	---
1371B:							
Crooksford -----	0-10	18-27	15.0-32.0	6.1-7.3	---	---	---
	10-25	18-30	8.0-20.0	6.6-7.8	0-10	---	---
	25-35	18-27	8.0-20.0	7.4-8.4	15-25	---	---
	35-60	18-30	7.0-18.0	7.4-8.4	10-20	---	---
Swanlake -----	0-9	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	9-46	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	46-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
1373C:							
Omsrud -----	0-7	20-26	14.0-35.0	5.6-7.3	---	---	---
	7-22	22-30	9.0-22.0	5.6-7.3	---	---	---
	22-60	22-30	7.0-16.0	7.4-8.4	5-30	---	---
Storden -----	0-10	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	10-23	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	23-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Hawick -----	0-9	2-10	1.0-10.0	6.1-7.8	0-10	---	---
	9-28	1-10	1.0-5.0	6.1-7.8	0-10	---	---
	28-60	1-5	1.0-5.0	7.4-8.4	5-15	---	---
1374:							
Havelock -----	0-23	27-35	30.0-36.0	7.4-8.4	5-30	---	---
	23-35	27-35	30.0-36.0	7.4-8.4	5-30	---	---
	35-60	12-26	10.0-20.0	7.4-8.4	5-30	---	---
1375D:							
Storden -----	0-9	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	9-24	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	24-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
Ves -----	0-8	18-30	14.0-27.0	6.1-7.8	---	---	---
	8-22	18-32	10.0-20.0	6.6-7.8	---	---	---
	22-44	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	44-60	18-32	---	7.4-8.4	10-20	---	---
1376C:							
Omsrud -----	0-10	20-26	14.0-35.0	5.6-7.3	---	---	---
	10-29	22-30	9.0-22.0	5.6-7.3	---	---	---
	29-60	22-30	7.0-16.0	7.4-8.4	5-30	---	---
Storden -----	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---	---
	7-55	18-30	9.0-18.0	7.4-8.4	15-30	---	---
	55-60	18-30	9.0-18.0	7.4-8.4	10-20	---	---
1382:							
Louris -----	0-13	18-27	20.0-33.0	7.4-8.4	5-30	---	---
	13-20	18-35	15.0-28.0	7.9-8.4	20-35	0-1	---
	20-31	18-27	13.0-21.0	7.4-8.4	10-20	0-1	---
	31-60	18-32	13.0-23.0	7.4-8.4	5-20	0-1	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
1386B:							
Amiret-----	0-12	18-32	14.0-27.0	6.1-7.3	---	---	---
	12-20	18-32	10.0-20.0	6.1-7.3	---	---	---
	20-50	18-32	10.0-18.0	7.4-8.4	15-25	---	---
	50-60	18-32	10.0-18.0	7.4-8.4	10-20	---	---
Swanlake-----	0-8	18-27	13.0-22.0	7.4-8.4	0-10	---	---
	8-15	18-30	9.0-19.0	7.4-8.4	10-25	---	---
	15-60	18-30	9.0-17.0	7.4-8.4	10-25	---	---
Hawick-----	0-8	5-15	1.0-10.0	6.1-7.8	0-10	---	---
	8-13	1-10	1.0-5.0	6.1-7.8	0-10	---	---
	13-60	1-5	1.0-5.0	7.4-8.4	5-15	---	---
1388B:							
Terril-----	0-27	18-26	20.0-25.0	6.1-7.3	---	---	---
	27-40	24-30	20.0-25.0	6.1-7.3	---	---	---
	40-60	22-30	15.0-25.0	6.1-7.8	0-15	---	---
1389:							
Havelock-----	0-30	10-26	30.0-36.0	7.4-8.4	5-30	---	---
	30-40	27-35	30.0-36.0	7.4-8.4	5-30	---	---
	40-60	12-26	10.0-20.0	7.4-8.4	5-30	---	---
1390:							
Leen-----	0-15	27-35	27.0-40.0	7.4-8.4	10-25	0-1	---
	15-25	18-35	15.0-30.0	7.9-8.4	20-35	0-1	---
	25-38	18-27	12.0-20.0	7.4-8.4	10-20	0-3	---
	38-60	18-32	13.0-24.0	7.4-8.4	10-20	0-3	---
1392B:							
Grogan-----	0-15	8-18	10.0-20.0	5.6-7.3	---	---	---
	15-38	8-18	7.0-15.0	6.1-7.8	0-5	---	---
	38-60	5-15	3.0-13.0	7.4-8.4	5-15	---	---
1802:							
Calcousta-----	0-12	27-35	30.0-36.0	7.4-8.4	5-30	---	---
	12-24	24-32	25.0-30.0	7.4-8.4	5-30	---	---
	24-60	22-30	25.0-30.0	7.4-8.4	5-30	---	---
Okoboji-----	0-6	20-30	41.0-50.0	6.1-7.8	0-15	---	---
	6-32	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	32-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
1833:							
Coland-----	0-18	27-35	30.0-36.0	6.1-7.3	---	---	---
	18-54	27-35	30.0-36.0	6.1-7.3	---	---	---
	54-60	12-26	20.0-30.0	6.1-7.8	0-20	---	---
1834:							
Coland-----	0-12	27-35	30.0-36.0	6.1-7.3	---	---	---
	12-28	27-35	30.0-36.0	6.1-7.3	---	---	---
	28-60	12-26	20.0-30.0	6.1-7.8	0-20	---	---
1845A:							
Estherville-----	0-12	10-18	5.0-23.0	5.6-7.3	---	---	---
	12-17	10-18	4.0-20.0	5.6-7.3	---	---	---
	17-60	0-8	0.0-5.0	6.6-8.4	0-15	---	---
1845B:							
Estherville-----	0-8	10-18	5.0-23.0	5.6-7.3	---	---	---
	8-13	10-18	4.0-20.0	5.6-7.3	---	---	---
	13-60	0-8	0.0-5.0	6.6-8.4	0-15	---	---

CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity
	In	Pct	meq/100g	pH	Pct	Pct	mmhos/cm
1900:							
Okoboji -----	0-12	20-30	41.0-50.0	6.1-7.8	0-15	---	---
	12-30	35-45	41.0-45.0	6.6-7.8	0-15	---	---
	30-60	25-35	36.0-41.0	6.6-8.4	0-30	---	---
Canisteo -----	0-19	27-32	19.0-37.0	7.4-8.4	5-15	---	---
	19-23	20-35	12.0-29.0	7.4-8.4	12-18	---	---
	23-39	10-35	6.0-23.0	7.4-8.4	10-15	---	---
	39-60	22-32	9.0-20.0	7.4-8.4	10-15	---	---
1917:							
Nishna -----	0-21	36-40	41.0-45.0	7.4-8.4	5-30	---	---
	21-60	38-46	30.0-36.0	7.4-8.4	5-30	---	---
1958:							
Danube -----	0-19	40-46	32.0-48.0	7.4-8.4	15-35	---	---
	19-31	12-30	9.0-23.0	7.4-8.4	15-25	---	---
	31-35	8-12	5.0-9.0	7.4-8.4	5-15	---	---
	35-60	1-8	1.0-6.0	7.4-8.4	5-15	---	---
1999:							
Minneiska -----	0-7	10-27	10.0-30.0	7.4-8.4	10-20	---	---
	7-60	5-18	5.0-15.0	7.4-8.4	5-20	---	---
Rushriver -----	0-46	10-22	5.0-20.0	7.4-8.4	5-25	---	---
	46-60	2-10	3.0-13.0	7.4-8.4	5-20	---	---

WATER FEATURES

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
27A: Dickinson-----	B	None	---	---	>6.0	---	---
27B: Dickinson-----	B	None	---	---	>6.0	---	---
35: Blue Earth-----	B/D	None	---	---	+1.0-0.5	Apparent	Jan-Dec
39A: Wadena-----	B	None	---	---	>6.0	---	---
39B: Wadena-----	B	None	---	---	>6.0	---	---
85: Calco-----	B/D	Occasional	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
86: Canisteo-----	B/D	None	---	---	0.5-1.5	Apparent	Oct-Jul
94C: Terril-----	B	None	---	---	>6.0	---	---
102B: Clarion-----	B	None	---	---	3.5-6.0	Apparent	Nov-Jul
112: Harps-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul
113: Webster-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul
118: Crippin-----	B	None	---	---	1.5-2.5	Apparent	Nov-Jun
128C2: Grogan-----	B	None	---	---	>6.0	---	---
130: Nicollet-----	B	None	---	---	2.0-3.5	Apparent	Mar-Jun
134: Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
156: Fairhaven-----	B	None	---	---	>6.0	---	---
211: Lura-----	C/D	None	---	---	+1.0-0.5	Apparent	Nov-Jul
227: Lemond-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-May
247: Linder-----	B	None	---	---	2.0-4.0	Apparent	Nov-Jul
255: Mayer-----	B/D	None	---	---	0.5-1.5	Apparent	Oct-Jun
282: Hanska-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun

WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
318: Mayer-----	B/D	None	---	---	+1.0-1.0	Apparent	Jan-Dec
327A: Dickman-----	A	None	---	---	>6.0	---	---
327B: Dickman-----	A	None	---	---	>6.0	---	---
327C: Dickman-----	A	None	---	---	>6.0	---	---
336: Delft-----	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun
386: Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
392: Biscay-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
423: Seaforth-----	B	None	---	---	2.5-4.0	Apparent	Mar-Jun
446: Normania-----	B	None	---	---	1.5-2.5	Apparent	Mar-Jun
463A: Minneiska-----	B	Occasional	Brief	Mar-Jul	2.5-4.0	Apparent	Mar-Jun
463B: Minneiska-----	B	Rare	---	---	2.5-4.0	Apparent	Mar-Jun
519: Klossner-----	A/D	None	---	---	+1.0-1.0	Apparent	Oct-Jul
525: Muskego-----	A/D	None	---	---	+1.0-1.0	Apparent	Nov-Aug
539: Klossner-----	A/D	None	---	---	+1.0-0.5	Apparent	Oct-Jul
574: Du Page-----	B	Occasional	Brief	Apr-Jun	4.0-6.0	Apparent	Feb-Jun
575: Nishna-----	C/D	Occasional	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
595F: Swanlake-----	B	None	---	---	>6.0	---	---
610: Calco-----	B/D	Frequent	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
770C2: Ves-----	B	None	---	---	>6.0	---	---
Terril-----	B	None	---	---	>6.0	---	---
810: Coriff-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
Fieldon-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun

WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
817: Canisteeo-----	B/D	None	---	---	0.5-1.5	Apparent	Oct-Jul
Seaforth-----	B	None	---	---	2.5-4.0	Apparent	Mar-Jun
875C: Hawick-----	A	None	---	---	>6.0	---	---
Estherville----	B	None	---	---	>6.0	---	---
887B: Clarion-----	B	None	---	---	3.5-6.0	Apparent	Nov-Jul
Swanlake-----	B	None	---	---	>6.0	---	---
899: Harps-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul
Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
920B: Clarion-----	B	None	---	---	3.5-6.0	Apparent	Nov-Jul
Storden-----	B	None	---	---	>6.0	---	---
Hawick-----	A	None	---	---	>6.0	---	---
927: Harps-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul
Seaforth-----	B	None	---	---	2.5-4.0	Apparent	Mar-Jun
Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
954C2: Ves-----	B	None	---	---	>6.0	---	---
Storden-----	B	None	---	---	>6.0	---	---
956: Canisteeo-----	B/D	None	---	---	0.5-1.5	Apparent	Oct-Jul
Glencoe-----	B/D	None	---	---	+1.0-0.5	Apparent	Oct-Jul
960D2: Storden-----	B	None	---	---	>6.0	---	---
Omsrud-----	B	None	---	---	>6.0	---	---
960F: Storden-----	B	None	---	---	>6.0	---	---
Omsrud-----	B	None	---	---	>6.0	---	---
978: Cordova-----	C/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
Rolfe-----	C	None	---	---	+1.0-1.0	Apparent	Nov-Jul
999C2: Ves-----	B	None	---	---	>6.0	---	---
Storden-----	B	None	---	---	>6.0	---	---

WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
999C2: Hawick-----	A	None	---	---	>6.0	---	---
1030: Pits.							
Udipsamments----	A	None	---	---	>6.0	---	---
1080: Klossner-----	D	None	---	---	+3.0-0.0	Apparent	Jan-Dec
Okoboji-----	D	None	---	---	+3.0-1.0	Apparent	Jan-Dec
Glencoe-----	D	None	---	---	+3.0-0.0	Apparent	Jan-Dec
1100: Nicollet-----	B	None	---	---	2.0-3.5	Apparent	Mar-Jun
1101: Webster-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul
1159B: Strout-----	C	None	---	---	2.5-4.0	Perched	Nov-Jul
Arkton-----	C	None	---	---	2.5-4.0	Perched	Nov-Jul
1162A: Kandiyohi-----	C/D	None	---	---	1.5-2.5	Perched	Nov-Jul
1169: Corvuso-----	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul
Lura-----	C/D	None	---	---	+1.0-0.5	Apparent	Nov-Jul
1193: Cosmos-----	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul
1205: Leen-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-May
Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
1242F: Swanlake-----	B	None	---	---	>6.0	---	---
Terril-----	B	None	---	---	>6.0	---	---
1261B: Bechyn-----	D	None	---	---	>6.0	---	---
1262: Seaforth-----	B	None	---	---	2.5-4.0	Apparent	Mar-Jun
1267: Cedarrock-----	D	Frequent	Brief	Mar-Jun	0.5-1.5	Perched	Oct-Jul
1268: Hanlon-----	B	Rare	---	---	3.0-5.0	Apparent	Nov-Jun
1269: Lowlein-----	B	None	---	---	2.5-4.0	Perched	Mar-Jun

WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
1270D: Bechyn-----	D	None	---	---	>6.0	---	---
Rock outcrop----	---	None	---	---	>6.0	---	---
1285: Chetomba-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
1286: Prinsburg-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
1287: Calco-----	B/D	Frequent	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
1355B: Amiret-----	B	None	---	---	3.5-6.0	Apparent	Mar-Jun
Swanlake-----	B	None	---	---	>6.0	---	---
1356: Water.							
1369A: Crooksford-----	B	None	---	---	2.0-3.5	Apparent	Nov-May
1369B: Crooksford-----	B	None	---	---	2.0-3.5	Apparent	Nov-May
1370B: Amiret-----	B	None	---	---	3.5-6.0	Apparent	Mar-Jun
1371B: Crooksford-----	B	None	---	---	2.0-3.5	Apparent	Nov-May
Swanlake-----	B	None	---	---	>6.0	---	---
1373C: Omsrud-----	B	None	---	---	>6.0	---	---
Storden-----	B	None	---	---	>6.0	---	---
Hawick-----	A	None	---	---	>6.0	---	---
1374: Havelock-----	B/D	Occasional	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
1375D: Storden-----	B	None	---	---	>6.0	---	---
Ves-----	B	None	---	---	>6.0	---	---
1376C: Omsrud-----	B	None	---	---	>6.0	---	---
Storden-----	B	None	---	---	>6.0	---	---
1382: Louris-----	B	None	---	---	1.5-2.5	Apparent	Nov-May
1386B: Amiret-----	B	None	---	---	3.5-6.0	Apparent	Mar-Jun
Swanlake-----	B	None	---	---	>6.0	---	---

WATER FEATURES--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
1386B: Hawick-----	A	None	---	---	Ft >6.0	---	---
1388B: Terril-----	B	None	---	---	3.5-6.0	---	---
1389: Havelock-----	B/D	Frequent	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul
1390: Leen-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-May
1392B: Grogan-----	B	None	---	---	3.5-6.0	Apparent	Mar-May
1802: Calcousta-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
1833: Coland-----	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul
1834: Coland-----	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul
1845A: Estherville-----	B	None	---	---	>6.0	---	---
1845B: Estherville-----	B	None	---	---	>6.0	---	---
1900: Okoboji-----	B/D	None	---	---	+1.0-1.0	Apparent	Nov-Jul
Canisteco-----	B/D	None	---	---	+1.0-1.0	Apparent	Jan-Dec
1917: Nishna-----	D	Frequent	Long	Mar-Nov	+1.0-1.0	Apparent	Jan-Dec
1958: Danube-----	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jun
1999: Minneiska-----	B	Frequent	Brief	Mar-Jul	2.5-4.0	Apparent	Mar-Jun
Rushriver-----	B/D	Frequent	Brief	Feb-Jun	0.5-1.5	Apparent	Nov-Aug

SOIL FEATURES

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
			In	In			
27A: Dickinson-----	>60	---	---	---	Moderate----	Low-----	Moderate.
27B: Dickinson-----	>60	---	---	---	Moderate----	Low-----	Moderate.
35: Blue Earth-----	>60	---	---	---	High-----	High-----	Low.
39A: Wadena-----	>60	---	---	---	Low-----	Low-----	Low.
39B: Wadena-----	>60	---	---	---	Low-----	Low-----	Low.
85: Calco-----	>60	---	---	---	High-----	High-----	Low.
86: Canisteo-----	>60	---	---	---	High-----	High-----	Low.
94C: Terril-----	>60	---	---	---	Moderate----	Moderate----	Low.
102B: Clarion-----	>60	---	---	---	Moderate----	Low-----	Low.
112: Harps-----	>60	---	---	---	High-----	High-----	Low.
113: Webster-----	>60	---	---	---	High-----	High-----	Low.
118: Crippin-----	>60	---	---	---	High-----	High-----	Low.
128C2: Grogan-----	>60	---	---	---	High-----	Low-----	Low.
130: Nicollet-----	>60	---	---	---	High-----	High-----	Low.
134: Okoboji-----	>60	---	---	---	High-----	High-----	Low.
156: Fairhaven-----	>60	---	---	---	Moderate----	Low-----	Moderate.
211: Lura-----	>60	---	---	---	High-----	High-----	Low.
227: Lemond-----	>60	---	---	---	High-----	High-----	Low.
247: Linder-----	>60	---	---	---	High-----	Moderate----	Low.
255: Mayer-----	>60	---	---	---	High-----	High-----	Low.
282: Hanska-----	>60	---	---	---	High-----	High-----	Low.

SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
318: Mayer-----	>60	---	---	---	High-----	High-----	Low.
327A: Dickman-----	>60	---	---	---	Low-----	Low-----	Moderate.
327B: Dickman-----	>60	---	---	---	Low-----	Low-----	Moderate.
327C: Dickman-----	>60	---	---	---	Low-----	Low-----	Moderate.
336: Delft-----	>60	---	---	---	High-----	High-----	Low.
386: Okoboji-----	>60	---	---	---	High-----	High-----	Low.
392: Biscay-----	>60	---	---	---	High-----	Moderate---	Low.
423: Seaforth-----	>60	---	---	---	High-----	High-----	Low.
446: Normania-----	>60	---	---	---	High-----	High-----	Low.
463A: Minneiska-----	>70	---	---	---	Moderate---	Low-----	Low.
463B: Minneiska-----	>70	---	---	---	Moderate---	Low-----	Low.
519: Klossner-----	>60	---	2-4	25-32	High-----	High-----	Moderate.
525: Muskego-----	>60	---	---	35-45	High-----	Moderate---	Moderate.
539: Klossner-----	>60	---	2-4	25-32	High-----	High-----	Moderate.
574: Du Page-----	>60	---	---	---	Moderate---	Low-----	Low.
575: Nishna-----	>80	---	---	---	Moderate---	High-----	Low.
595F: Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.
610: Calco-----	>60	---	---	---	High-----	High-----	Low.
770C2: Ves-----	>60	---	---	---	Moderate---	Low-----	Low.
Terril-----	>60	---	---	---	Moderate---	Moderate---	Low.
810: Coriff-----	>60	---	---	---	High-----	High-----	Low.
Fieldon-----	>60	---	---	---	High-----	High-----	Low.

SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
817:							
Canisteco-----	>60	---	---	---	High-----	High-----	Low.
Seaforth-----	>60	---	---	---	High-----	High-----	Low.
875C:							
Hawick-----	>60	---	---	---	Low-----	Low-----	Low.
Estherville----	>60	---	---	---	Low-----	Low-----	Low.
887B:							
Clarion-----	>60	---	---	---	Moderate---	Low-----	Low.
Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.
899:							
Harps-----	>60	---	---	---	High-----	High-----	Low.
Okoboji-----	>60	---	---	---	High-----	High-----	Low.
920B:							
Clarion-----	>60	---	---	---	Moderate---	Low-----	Low.
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
Hawick-----	>60	---	---	---	Low-----	Low-----	Low.
927:							
Harps-----	>60	---	---	---	High-----	High-----	Low.
Seaforth-----	>60	---	---	---	High-----	High-----	Low.
Okoboji-----	>60	---	---	---	High-----	High-----	Low.
954C2:							
Ves-----	>60	---	---	---	Moderate---	Low-----	Low.
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
956:							
Canisteco-----	>60	---	---	---	High-----	High-----	Low.
Glencoe-----	>60	---	---	---	High-----	High-----	Low.
960D2:							
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
Omsrud-----	>60	---	---	---	Moderate---	Low-----	Low.
960F:							
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
Omsrud-----	>60	---	---	---	Moderate---	Low-----	Low.
978:							
Cordova-----	>80	---	---	---	High-----	High-----	Low.
Rolfe-----	>60	---	---	---	High-----	High-----	Moderate.
999C2:							
Ves-----	>60	---	---	---	Moderate---	Low-----	Low.
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.

SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
999C2: Hawick-----	>60	---	---	---	Low-----	Low-----	Low.
1030: Pits.							
Udipsamments-----	>60	---	---	---	Low-----	Low-----	Low.
1080: Klossner-----	>60	---	2-4	25-32	High-----	High-----	Moderate.
Okoboji-----	>60	---	---	---	High-----	High-----	Low.
Glencoe-----	>60	---	---	---	High-----	High-----	Low.
1100: Nicollet-----	>60	---	---	---	High-----	High-----	Low.
1101: Webster-----	>60	---	---	---	High-----	High-----	Low.
1159B: Strout-----	>60	---	---	---	Moderate---	High-----	Low.
Arkton-----	>60	---	---	---	High-----	High-----	Low.
1162A: Kandiyohi-----	>60	---	---	---	High-----	High-----	Low.
1169: Corvuso-----	>60	---	---	---	High-----	High-----	Low.
Lura-----	>60	---	---	---	High-----	High-----	Low.
1193: Cosmos-----	>60	---	---	---	High-----	High-----	Low.
1205: Leen-----	>80	---	---	---	High-----	High-----	Low.
Okoboji-----	>60	---	---	---	High-----	High-----	Low.
1242F: Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.
Terril-----	>60	---	---	---	Moderate---	Moderate---	Low.
1261B: Bechyn-----	8-20	Hard	---	---	Moderate---	Low-----	Low.
1262: Seaforth-----	>60	---	---	---	High-----	High-----	Low.
1267: Cedarrock-----	24-40	Hard	---	---	High-----	High-----	Low.
1268: Hanlon-----	>60	---	---	---	Moderate---	Moderate---	Low.
1269: Lowlein-----	>60	---	---	---	Moderate---	Moderate---	Low.

SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
			In	In			
1270D: Bechyn-----	8-20	Hard	---	---	Moderate---	Low-----	Low.
Rock outcrop----	0-4	Hard	---	---	---	---	---
1285: Chetomba-----	>80	---	---	---	High-----	High-----	Low.
1286: Prinsburg-----	>80	---	---	---	High-----	High-----	Low.
1287: Calco-----	>60	---	---	---	High-----	High-----	Low.
1355B: Amiret-----	>60	---	---	---	Moderate---	Low-----	Low.
Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.
1356: Water.							
1369A: Crooksford-----	>80	---	---	---	High-----	Moderate---	Low.
1369B: Crooksford-----	>80	---	---	---	High-----	Moderate---	Low.
1370B: Amiret-----	>60	---	---	---	Moderate---	Low-----	Low.
1371B: Crooksford-----	>80	---	---	---	High-----	Moderate---	Low.
Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.
1373C: Omsrud-----	>60	---	---	---	Moderate---	Low-----	Low.
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
Hawick-----	>60	---	---	---	Low-----	Low-----	Low.
1374: Havelock-----	>60	---	---	---	High-----	High-----	Low.
1375D: Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
Ves-----	>60	---	---	---	Moderate---	Low-----	Low.
1376C: Omsrud-----	>60	---	---	---	Moderate---	Low-----	Low.
Storden-----	>60	---	---	---	Moderate---	Low-----	Low.
1382: Louris-----	>80	---	---	---	High-----	High-----	Low.
1386B: Amiret-----	>60	---	---	---	Moderate---	Low-----	Low.
Swanlake-----	>60	---	---	---	Moderate---	Low-----	Low.

SOIL FEATURES--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
1386B: Hawick-----	>60	---	---	---	Low-----	Low-----	Low.
1388B: Terril-----	>60	---	---	---	Moderate---	Moderate---	Low.
1389: Havelock-----	>60	---	---	---	High-----	High-----	Low.
1390: Leen-----	>80	---	---	---	High-----	High-----	Low.
1392B: Grogan-----	>60	---	---	---	High-----	Low-----	Low.
1802: Calcousta-----	>60	---	---	---	High-----	High-----	Low.
Okoboji-----	>60	---	---	---	High-----	High-----	Low.
1833: Coland-----	>60	---	---	---	High-----	High-----	Low.
1834: Coland-----	>60	---	---	---	High-----	High-----	Low.
1845A: Estherville----	>60	---	---	---	Low-----	Low-----	Low.
1845B: Estherville----	>60	---	---	---	Low-----	Low-----	Low.
1900: Okoboji-----	>60	---	---	---	High-----	High-----	Low.
Canisteco-----	>60	---	---	---	High-----	High-----	Low.
1917: Nishna-----	>60	---	---	---	Moderate---	High-----	Low.
1958: Danube-----	>60	---	---	---	High-----	High-----	Low.
1999: Minneiska-----	>70	---	---	---	Moderate---	Low-----	Low.
Rushriver-----	>60	---	---	---	High-----	Moderate---	Low.

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

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.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

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.

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

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile are commonly steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

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.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed

limestone, per unit area, with the same degree of distortion.

- 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.
- Chiseling.** Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface.
- 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.
- 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 is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.
- 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.
- Compressible** (in tables). Excessive decrease in volume of soft soil under load.
- Concretions.** Grains, pellets, or nodules of various

sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation 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 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. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where wind erosion is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

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.—Readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

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.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

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. 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.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—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 or high 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 most field crops are affected. 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 under natural conditions. 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. Poor drainage is 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 for rice) under natural conditions.

Drainage, surface. Runoff, or surface flow of water, from an area.

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.

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.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are

removed by sheet or rill erosion.

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. The term is more often applied to cliffs resulting from differential erosion.

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.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

Foot slope. The geomorphic component that forms the inner, gently inclined surface at the base of a hill slope. The surface is dominantly concave. In terms of gradational processes, a foot slope is a transition zone between an upslope site of erosion (back slope) and a downslope site of deposition (toe slope).

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

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.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their

relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

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.

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.

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 50 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 underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

High-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

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 6 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. 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 humified 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.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

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.

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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a

constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2.....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low
0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5.....	very high

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.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

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.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well-sorted, generally fine-textured, stratified deposits, commonly containing varves.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lake shore in front of a scarp line of low cliffs and later exposed when the water level falls.

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.

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.

Low-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

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.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

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 glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

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).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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.

Neutral soil. A soil having a pH value between 6.6 and 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 plain. An extensive area of glaciofluvial material that was deposited by meltwater streams.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Parts per million (ppm). The concentration of a substance in the soil, such as phosphorus or potassium, in one million parts of air-dried soil on a weight per weight basis.

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 movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Extremely slow	less than 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

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

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.

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.

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.

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.

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:

Extremely acid	less than 4.5
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

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 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.

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.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-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.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

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.** The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. 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.
- Silica.** A combination of silicon and oxygen. The mineral form is called quartz.
- 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.
- 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.
- 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.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in 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.
- 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 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 substratum. The living roots and plant and animal activities are largely confined to the solum.
- Stone line.** A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.
- 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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform, such as a hill, mountain, or tableland. It usually refers to a high interfluvial area of gentler slope that is flanked by steeper hillslopes, e.g., mountain fronts or tableland escarpments.

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.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine due to uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to

a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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 too thin for the specified use.

Till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Till plain. An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill. Toe slopes are commonly gentle and linear in profile.

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 salts, 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.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variation. 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.

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 oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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