

Soil Survey of Otter Tail County, Minnesota

Part I



This page intentionally left blank.

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**, 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** 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**. 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 **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also, see the **Contents** in Part I and Part II for other 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 1994. Soil names and descriptions were approved in 1995. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1994. 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 Otter Tail County Soil and Water Conservation Districts. Other assistance was provided by the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey was partially funded by the Legislative Commission for Minnesota Resources and by Otter Tail County.

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.

The United States Department of Agriculture (USDA) prohibits discrimination in all of its programs on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact the USDA's TARGET Center at 202-720-2600 (voice or TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue SW, Washington, DC 20250-9410, or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

Cover: *Upper left corner*—An area of the Snellman-Naytahwaush-Lida association. Most areas are used as woodland or pasture; the less sloping areas are used for crops. Controlling water erosion and maintaining water quality are the most critical concerns in this association. *Upper right corner*—An area of the Chapett-Sisseton-Friberg association. Cropland is the dominant land use in this area. *Lower right corner*—An area of the Blowers-Paddock-Cathro association. Most areas are used for forage crops or corn for the dairy operations in this part of the county. Because of the large number of stones in this association, rock removal is an important element in the management of the soils. *Lower left corner*—An area of the Kandota-Knute-Brandsvold association. Most areas are used for forage crops or corn for the dairy operations in this part of the county.

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

Contents

How to Use This Soil Survey	3	9. Waukon-Cathro-Gonvick Association	33
Index to Series	6	10. Nidaros-Seelyeville-Pinelake Association	34
Index to Map Units	8	11. Hubbard-Duelm-Nidaros Association	36
Foreword	13	12. Dorset-Corliss-Nidaros Association	36
How This Survey Was Made	15	13. Arvilla-Sverdrup-Sandberg Association	36
General Nature of the Survey Area	16	14. Bluffcreek-Nidaros-Epoufette Association	37
Tables:		15. Lida-Two Inlets-Nidaros Association	38
Temperature and Precipitation	23	16. Hamerly-Rockwell-Mustinka Association ...	39
Freeze Dates in Spring and Fall	24	17. Rockwell-Wolverton-Foldahl Association ...	40
Growing Season	25	Formation and Classification of the Soils	41
General Soil Map Units	27	Tables:	
1. Blowers-Paddock-Cathro Association	27	Classification of the Soils	45
2. Chapett-Sisseton-Friberg Association	27	Acreage and Proportionate Extent of the Soils	47
3. Sisseton-Heimdal-Quam Association	29	Soil Series and Detailed Soil Map Units	51
4. Formdale-Aazdahl-Parnell Association	29	References	245
5. Barnes-Langhei-Lakepark Association	30	Glossary	247
6. Snellman-Naytahwaush-Lida Association	30		
7. Forman-Buse-Peever Association	31		
8. Kandota-Knute-Brandsvold Association	32		

Index to Series

Aazdahl series	52	Hangaard series	124
Abbeylake series	53	Hantho series	125
Almora series	54	Haslie series	126
Arveson series	57	Haug series	128
Arvilla series	58	Heimdal series	129
Barnes series	61	Hillview series	130
Becida series	62	Hubbard series	131
Bemidji series	64	Isan series	133
Blowers series	65	Kandota series	134
Bluffcreek series	66	Kittson series	138
Bluffton series	69	Knute series	139
Borup series	70	Kratka series	142
Brandsvold series	72	Lakepark series	144
Buse series	73	Lamoure series	145
Bygland series	74	Langhei series	146
Cathro series	76	Leaflake series	147
Chapett series	77	Leafriver series	149
Clearriver series	82	Lida series	150
Clitherall series	83	Lindaas series	155
Clontarf series	85	Lizzie series	156
Clotho series	86	Mahkonce series	163
Corliss series	87	McIntosh series	164
Darnen series	91	Meehan series	165
Dent series	92	Mehurin series	166
Dickey series	93	Mustinka series	167
Doran series	94	Naytahwaush series	169
Dorset series	95	Nidaros series	171
Duelm series	98	Nitche series	173
Eagleview series	100	Oakcreek series	176
Egeland series	100	Oylen series	177
Egglake series	102	Paddock series	179
Epoufette series	104	Parnell series	180
Flaming series	106	Peever series	182
Foldahl series	107	Pinelake series	184
Forada series	108	Quam series	186
Fordville series	109	Radium series	188
Forman series	110	Rifle series	189
Formdale series	113	Rockwell series	190
Foxhome series	115	Rockwood series	191
Friberg series	117	Roliss series	193
Glyndon series	118	Roscommon series	194
Gonvick series	119	Rosy series	195
Grimstad series	120	Rothsay series	197
Hamerly series	122	Runeberg series	198

Rushlake series	199	Two Inlets series	226
Sandberg series	201	Urness series	227
Sedgeville series	204	Vallers series	228
Seelyeville series	206	Verndale series	229
Sioux series	208	Waukon series	232
Sisseton series	209	Weetown series	237
Snellman series	211	Winger series	238
Sugarbush series	218	Wolverton series	239
Sverdrup series	219	Wykeham series	240
Swenoda series	221	Wyndmere series	241
Sybil series	223	Zell series	243

Index to Map Units

7A—Hubbard loamy sand, 0 to 2 percent slopes	132	180—Gonvick loam	120
7B—Hubbard loamy sand, 2 to 6 percent slopes	132	184—Hamerly loam	122
7C—Hubbard loamy sand, 6 to 12 percent slopes	133	187—Haug muck	128
26—Aazdahl clay loam	53	191—Epoufette sandy loam	105
34—Parnell silty clay loam, depressional	181	202—Meehan loamy sand	166
38B—Waukon loam, 2 to 6 percent slopes	233	258A—Sandberg loamy sand, 0 to 2 percent slopes	202
38C2—Waukon loam, 6 to 12 percent slopes, eroded	233	258B—Sandberg loamy sand, 1 to 6 percent slopes	202
38D2—Waukon loam, 12 to 20 percent slopes, eroded	234	258C—Sandberg loamy sand, 6 to 12 percent slopes	203
38E—Waukon loam, 20 to 30 percent slopes	234	260—Duelm loamy sand	99
46—Borup loam	71	267B—Snellman sandy loam, 2 to 8 percent slopes	212
53B—Kandota sandy loam, 2 to 6 percent slopes	135	267C—Snellman sandy loam, 8 to 15 percent slopes	213
53C—Kandota sandy loam, 6 to 12 percent slopes	136	267E—Snellman sandy loam, 15 to 30 percent slopes	213
53D—Kandota sandy loam, 12 to 20 percent slopes	136	267F—Snellman sandy loam, 30 to 45 percent slopes	214
58—Kittson loam	139	290—Rothsay silt loam	197
59—Grimstad fine sandy loam	121	293B—Swenoda fine sandy loam, 1 to 4 percent slopes	222
61—Arveson loam	57	335—Urness mucky silt loam	228
63—Rockwell loam	191	339—Fordville loam	110
65—Foxhome sandy loam	116	341A—Arvilla sandy loam, 0 to 2 percent slopes	59
66—Flaming loamy fine sand	106	341B—Arvilla sandy loam, 2 to 6 percent slopes	59
68—Arveson loam, depressional	58	371—Clontarf sandy loam	86
107—Winger silt loam	238	375—Forada loam	108
108—McIntosh silt loam	165	402C—Sioux loamy sand, 2 to 12 percent slopes	208
121—Wykeham fine sandy loam	241	402E—Sioux loamy sand, 12 to 40 percent slopes	209
127A—Sverdrup sandy loam, 0 to 2 percent slopes	219	406A—Dorset sandy loam, 0 to 2 percent slopes	96
127B—Sverdrup sandy loam, 2 to 6 percent slopes	220	406B—Dorset sandy loam, 2 to 6 percent slopes	97
127C—Sverdrup sandy loam, 6 to 12 percent slopes	220	418—Lamoure silty clay loam, occasionally flooded	145
141B—Egeland fine sandy loam, 1 to 6 percent slopes	101	422B—Bygland silty clay loam, 1 to 6 percent slopes	75
141C—Egeland fine sandy loam, 6 to 12 percent slopes	101	422C—Bygland silty clay loam, 6 to 15 percent slopes	75
141D—Egeland fine sandy loam, 12 to 20 percent slopes	102		
168B—Forman clay loam, 2 to 6 percent slopes	111		

426—Foldahl loamy fine sand	107	716D—Leaflake-Eagleview complex, 12 to 20 percent slopes	149
441A—Almora loam, 0 to 2 percent slopes	55	718E—Naytahwaush loam, 15 to 30 percent slopes	170
441B—Almora loam, 2 to 6 percent slopes	56	721B—Corliss loamy sand, 2 to 6 percent slopes	88
441C—Almora loam, 6 to 12 percent slopes	56	721C—Corliss loamy sand, 6 to 12 percent slopes	88
481—Kratka fine sandy loam	143	721D—Corliss loamy sand, 12 to 20 percent slopes	89
494—Darnen loam, moderately wet	91	721E—Corliss loamy sand, 20 to 35 percent slopes	89
497—Hantho silt loam	125	726—Kratka sandy loam, thick solum, depressional	143
508—Wyndmere fine sandy loam	242	746—Haslie muck	126
540—Seelyeville muck	207	760C2—Chapett-Sisseton complex, 6 to 12 percent slopes, eroded	78
541—Rifle mucky peat	190	760D2—Chapett-Sisseton complex, 12 to 20 percent slopes, eroded	78
544—Cathro muck	76	769B—Mehurin clay loam, 1 to 4 percent slopes	167
567A—Verndale sandy loam, 0 to 2 percent slopes	230	776B—Snellman-Sugarbush complex, 2 to 8 percent slopes	214
567B—Verndale sandy loam, 2 to 6 percent slopes	231	776C—Snellman-Sugarbush complex, 8 to 15 percent slopes	215
609B—Dickey loamy fine sand, 1 to 5 percent slopes	94	776E—Snellman-Sugarbush complex, 15 to 30 percent slopes	215
624—Rosy sandy loam	196	777C2—Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded	210
646C—Peever clay loam, 6 to 12 percent slopes	182	777D2—Sisseton-Heimdal complex, 12 to 20 percent slopes, eroded	210
646D—Peever clay loam, 12 to 18 percent slopes	183	777E—Sisseton-Heimdal complex, 20 to 30 percent slopes	211
670—Knutte fine sandy loam	140	778B—Dorset-Corliss complex, 1 to 6 percent slopes	97
680—Parnell silt loam	181	778C—Dorset-Corliss complex, 6 to 12 percent slopes	98
698—Doran clay loam	95	779B—Peever-Mehurin complex, 2 to 6 percent slopes	183
701—Runeberg mucky loam, depressional	199	902B—Barnes-Buse complex, 2 to 6 percent slopes	61
705B—Nitche-Kandota-Lida complex, 1 to 6 percent slopes	174	903C2—Barnes-Langhei complex, 6 to 12 percent slopes, eroded	62
705C—Nitche-Kandota-Lida complex, 6 to 12 percent slopes	175	915C2—Forman-Buse complex, 6 to 12 percent slopes, eroded	112
707B—Lizzie silt loam, 2 to 6 percent slopes	161		
707C2—Lizzie silt loam, 6 to 12 percent slopes, eroded	162		
707D2—Lizzie silt loam, 12 to 20 percent slopes, eroded	162		
710—Friberg-Weetown complex	117		
711B—Arvilla-Sandberg complex, 2 to 6 percent slopes	60		
711C—Arvilla-Sandberg complex, 6 to 12 percent slopes	60		
715—Bluffcreek-Clearriver complex	67		
716B—Leaflake-Eagleview complex, 1 to 6 percent slopes	148		
716C—Leaflake-Eagleview complex, 6 to 12 percent slopes	148		

915D2—Forman-Buse complex, 12 to 20 percent slopes, eroded	112	1136—Nidaros muck	172
931C2—Formdale-Langhei complex, 6 to 12 percent slopes, eroded	114	1149—Hamerly clay loam	123
931D2—Formdale-Langhei complex, 12 to 20 percent slopes, eroded	114	1195A—Sybil-Eagleview complex, 0 to 2 percent slopes	223
942D2—Langhei-Barnes complex, 12 to 20 percent slopes, eroded	146	1195B—Sybil-Eagleview complex, 2 to 8 percent slopes	224
957B2—Rothsay-Zell complex, 2 to 6 percent slopes, eroded	198	1195C—Sybil-Eagleview complex, 8 to 15 percent slopes	224
969C2—Zell-Rothsay complex, 6 to 12 percent slopes, eroded	243	1195E—Sybil-Eagleview complex, 15 to 30 percent slopes	225
969D2—Zell-Rothsay complex, 12 to 20 percent slopes, eroded	244	1196B—Lida-Two Inlets complex, 1 to 8 percent slopes	151
1015—Udipsamments (cut and fill land)	227	1196C—Lida-Two Inlets complex, 8 to 15 percent slopes	152
1016—Udorthents, loamy (cut and fill land)	227	1196E—Lida-Two Inlets complex, 15 to 30 percent slopes	152
1027—Udorthents, wet substratum (fill land)	227	1196F—Lida-Two Inlets complex, 30 to 50 percent slopes	153
1030—Pits, gravel-Udipsamments complex	186	1200—Egglake loam	103
1077—Forada and Leafriver soils, depressional	109	1208B—Naytahwaush-Mahkonce complex, 1 to 8 percent slopes	170
1102B—Chapett-Dorset complex, 1 to 6 percent slopes	79	1209C—Naytahwaush clay loam, 8 to 15 percent slopes, eroded	171
1102C—Chapett-Dorset complex, 6 to 12 percent slopes, eroded	79	1212B—Mahkonce clay loam, 1 to 4 percent slopes	164
1103—Clitherall sandy loam	84	1214—Mustinka silty clay loam	168
1104B—Waukon-Dorset complex, 1 to 6 percent slopes	235	1215—Pinelake sandy loam	185
1104C—Waukon-Dorset complex, 6 to 12 percent slopes, eroded	235	1216B—Egglake-Wykeham complex, 0 to 5 percent slopes	104
1104D—Waukon-Dorset complex, 12 to 20 percent slopes, eroded	236	1217E—Waukon-Lida complex, 20 to 35 percent slopes	236
1105B—Dent silt loam, 1 to 6 percent slopes	93	1218B—Snellman-Lida complex, 1 to 8 percent slopes	216
1110—Isan sandy loam	134	1218C—Snellman-Lida complex, 8 to 15 percent slopes	216
1111—Nidaros muck, frequently flooded	172	1218E—Snellman-Lida complex, 15 to 30 percent slopes	217
1112D—Chapett-Corliss complex, 12 to 20 percent slopes, eroded	80	1218F—Snellman-Lida complex, 30 to 45 percent slopes	217
1112E—Chapett-Corliss complex, 20 to 30 percent slopes	81	1219C—Sandberg-Sverdrup complex, 6 to 12 percent slopes	203
1113—Haslie, Seelyeville, and Cathro soils, ponded	127	1221B—Sverdrup-Sandberg complex, 2 to 6 percent slopes	221
1114—Hangaard loamy sand, lake beaches	124	1223D—Sandberg-Arvilla complex, 12 to 20 percent slopes	204
1120—Rushlake-Hangaard complex	200		
1129—Lindaas silty clay loam, morainic	156		
1131B—Verndale-Abbeylake complex, 1 to 6 percent slopes	231		

1227—Quam, Cathro, and Urness soils, ponded	187	1319D—Rockwood sandy loam, 12 to 20 percent slopes, stony	193
1230—Haslie and Nidaros soils, ponded	127	1320B—Blowers sandy loam, 1 to 5 percent slopes, stony	66
1232B—Chapett loam, 2 to 6 percent slopes	81	1321—Paddock-Becida complex, stony	180
1232E—Chapett loam, 20 to 30 percent slopes	82	1322—Wolverton very fine sandy loam	240
1234B—Formdale-Buse complex, 2 to 6 percent slopes	115	1324B—Heimdal-Sisseton complex, 2 to 6 percent slopes	129
1237—Lakepark loam	144	1338—Oakcreek loam	177
1239—Quam silt loam	188	1339—Borup mucky silt loam, depressional	71
1240—Roliss clay loam	194	1340—Bluffcreek-Epoufette complex	68
1247D—Corliss-Dorset complex, 12 to 20 percent slopes	90	1341—Clitherall-Wykeham complex	85
1250C—Abbeylake-Verndale complex, 6 to 12 percent slopes	54	1342—Pinelake, loamy substratum-Brandsvold complex	185
1259—Hamerly-Mustinka complex	123	1343C—Lida-Almora-Lizzie complex, 8 to 15 percent slopes	153
1275B—Kandota-Egglake, depressional, complex, 0 to 8 percent slopes	137	1344B—Lida-Almora-Dent complex, 1 to 8 percent slopes	154
1275C—Kandota-Egglake, depressional, complex, 0 to 15 percent slopes	137	1345—Bluffcreek-Rosy complex	68
1276—Knute-Brandsvold complex, thick solum	140	1346—Nidaros muck, calcareous	173
1277D—Corliss-Sverdrup complex, 12 to 20 percent slopes	90	1347B—Kandota loam, 1 to 6 percent slopes	138
1289—Knute fine sandy loam, thick solum	141	1348—Knute loam, thick solum	142
1290—Brandsvold fine sandy loam, thick solum	73	1349—Clotho loam, moderately permeable	87
1291—Sedgeville loam, frequently flooded	205	1350—Brandsvold loam, thick solum	73
1293—Sedgeville fine sandy loam, rarely flooded	205	1351—Bluffton loam, moderately permeable	70
1304A—Glyndon very fine sandy loam	119	1356—Water, miscellaneous	232
1307—Rushlake sand	200	1365—Hillview fine sandy loam	131
1317—Vallers silty clay loam	229	1396—Sedgeville, Nidaros, and Aquolls soils, channeled	206
1319B—Rockwood sandy loam, 2 to 6 percent slopes, stony	192	1397—Bemidji loamy sand, moderately permeable	64
1319C—Rockwood sandy loam, 6 to 12 percent slopes, stony	192	1825B—Seelyeville muck, seep land, 1 to 10 percent slopes	207
		1874—Radium loamy sand	189
		1943—Roscommon loamy sand	195
		1975—Oylen sandy loam	178
		W—Water	232

This page intentionally left blank.

Foreword

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

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

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

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

William Hunt
State Conservationist
Natural Resources Conservation Service

This page intentionally left blank.

Soil Survey of Otter Tail County, Minnesota

By David L. Aldeen and Michael L. Lieser, Natural Resources Conservation Service

Fieldwork by David L. Aldeen, Laurie M. Brown, Keith A. Christensen, Jerome F. Gorton, Peter R. Hartman, Michael L. Lieser, Craig A. Prink, and Roger T. Risley, Natural Resources Conservation Service; Kermit E. Larson, Minnesota Agricultural Experiment Station; Ward J. Aas, Vikingland Soil Survey, Inc.; and Malvern N. Jacobson, Jacobson Soil Survey Consultants, Inc.

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

How This Survey Was Made

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

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

miscellaneous area at a specific location on the landscape.

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

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

same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

General Nature of the Survey Area

Otter Tail County is in west-central Minnesota (fig. 1). It has a total area of about 2,232 square miles, or about 1,423,300 acres. The total land area is about 1,190,100 acres. The total area of water in the county is about 233,200 acres (USDA, 1984). Fergus Falls,

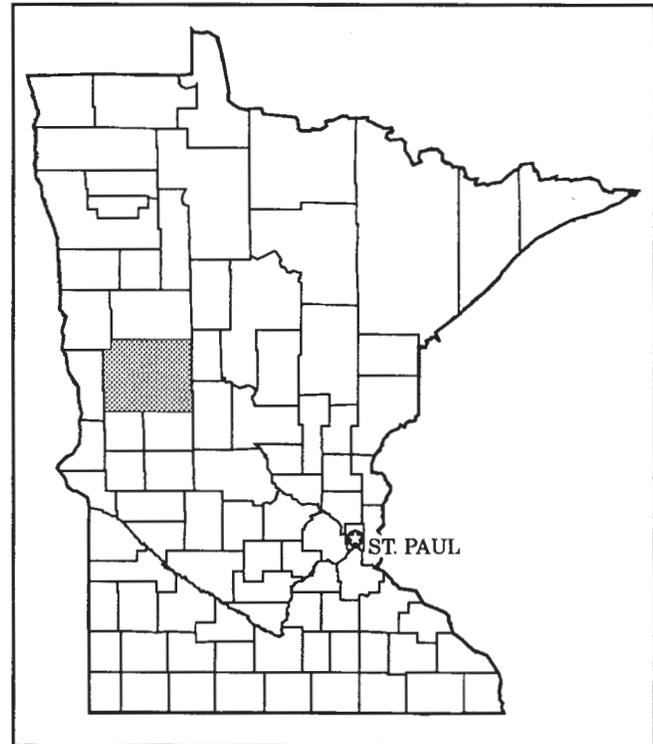


Figure 1.—Location of Otter Tail County in Minnesota.

the county seat, is in the southwestern part of the county. In 1990, the population of Otter Tail County was 50,714.

The agricultural enterprises in the county are mainly dairy farming, cash crops, and livestock and poultry operations. A significant part of the county's economy involves tourism, sport fishing, and recreational uses associated with the many lakes and rivers. Most of the light industrial products manufactured in the county are related to agriculture or recreation.

Some forest management and harvesting produces saw logs, pulpwood, and Christmas trees.

This survey updates an incomplete farm tract soil mapping project for Otter Tail County. It includes mapping of previously unmapped areas and updates the interpretations for the soil types in the county.

Soil scientists were denied access to a few tracts in the county. These areas are indicated by a dashed line around the tract. Soil scientists mapped these areas using knowledge from the surrounding areas, older soil maps, and photo interpretation of aerial photographs. The descriptions and map unit delineations of the soils on these tracts may be less accurate than those in areas where the soil scientists had access and could carefully examine the soils.

History and Settlement

Native Americans used the survey area for hunting and fishing and had permanent dwelling sites. Two Native American tribes were in constant conflict. The Dakota (Sioux) were being pushed from their home area by the Ojibwa (Chippewa) during the late 1700's and early 1800's. Burial mounds and artifacts can still be found. Some of the oldest remains of Native Americans were found near Pelican Rapids, Minnesota. The remains, nicknamed Minnesota Girl, were dated at about 11,000 B.C. (Otter Tail County Historical Museum).

The first white men to enter the county were French and British fur traders. Efforts were made to set up trading posts on the Leaf Lakes and Otter Tail Lake. In the late 1800's, most of the towns were built along the railroad lines. Lumber and agriculture were the major industries in the county at that time. The pine and hardwood forests, transportation system, and markets were instrumental in the development of Fergus Falls into a lumber center.

In 1870, the population of the county was about 2,000. At that time the principal languages spoken in the county were Norwegian, Swedish, German, and English (Mason, 1916).

Otter Tail County was established in March 1858 by a legislative act. It was organized in 1868. The original county seat was Otter Tail City. The people of Fergus Falls organized a new county named Holcomb. In 1872, a legislative act abolished Holcomb County, added additional townships to the west, and established Fergus Falls as the county seat of Otter Tail County. There are 62 townships in the county. The county is named for Otter Tail Lake and the Otter Tail River.

Farming

At the time of its early settlement, about two-thirds of the survey area was forested and one-third was native prairie. Today, about 20 percent of the county is forested and 80 percent is used as cropland or pastureland. In the early years, wheat was the dominant crop grown. At several times throughout Otter Tail County's farming history, the grasshopper infestations were so terrible that bounties on grasshoppers were enacted. The production of corn and other crops did not begin until about 1905.

The Food Security Act of 1985 included the Conservation Reserve Program. This program involved taking selected cropland acres out of commodity crop production for 10 years and planting those areas to trees or other vegetative cover for the

purpose of controlling erosion. From October 1985 to the present, Otter Tail County has had approximately 80,000 acres in the Conservation Reserve Program. Former cropland could be brought back into crop production starting in October 1995, as the Conservation Reserve Program contracts started to expire.

Otter Tail County holds an impressive agricultural standing in Minnesota. In 1994, the county ranked first in production of hay, oats, and dry edible beans and ranked second in stock sheep and lambs, milk cows and milk production, cattle and calves, and total livestock in the State of Minnesota. It ranked third in overall cash receipts. In 1994, there were about 2,950 farms in Otter Tail County and the average farm size was about 335 acres. Approximately 550,000 acres in the county is used for the production of crops. During the 1994 growing season, 148,100 acres was planted to corn for grain; 37,700 acres was used for corn silage; 130,600 acres was used for hay, of which 107,300 acres was alfalfa hay; 45,100 acres was used for oats; 62,500 acres was used for spring wheat; 72,700 acres was used for soybeans; 20,100 acres was used for barley; 14,900 acres was used for dry edible beans; 11,500 acres was used for sunflowers; and 2,600 acres was used for sugarbeets. Minor acreages of other crops included potatoes, buckwheat, and rye (USDA and others, 1995).

Transportation Facilities and Markets

Some present-day highways, roads, and railroad grades follow the old trails and oxen-cart paths made by Native Americans and the first white settlers that traveled through Otter Tail County. Interstate 94 from St. Cloud closely follows an old oxen-cart trail that connected with the old Red River Trail. State and Federal highways include Interstate 94, U.S. Highways 10 and 59, and Minnesota Highways 210, 108, 29, and 78. Interstate 94 crosses the southwest corner of the county and serves Fergus Falls. U.S. Highway 10 crosses the northeast corner of the county and passes through the cities of Bluffton, New York Mills, and Perham. U.S. Highway 59 is a north-south route through Fergus Falls that heads north to Canada. Minnesota Highway 210 crosses from east to west across the southern half of the county and serves the communities of Fergus Falls, Battle Lake, and Henning. Minnesota Highway 29 extends from the city of Wadena south through Parkers Prairie into Douglas County. Minnesota Highway 78 extends south from Perham through the central part of the county to Battle Lake and continues south to Douglas County.

Minnesota Highway 108 heads west from Perham and connects with Interstate 94.

Three railway systems serve the county. One crosses the northeastern part of the county through Perham en route to the west coast; one crosses the southeastern part of the county and serves Fergus Falls; and the third crosses the central part of the county as it heads to the Canadian border.

Grain elevators are located in cities and towns throughout the county. Grain crops are marketed mainly in Fargo, North Dakota, and in Minneapolis, St. Paul, and Duluth, Minnesota. There is a sugarbeet processing plant in Wahpeton, North Dakota.

Livestock are marketed locally in the county at Fergus Falls and Perham, or they are marketed at West Fargo, North Dakota; Sisseton, South Dakota; or South St. Paul, Minnesota. A turkey processing plant is located at Pelican Rapids. A cheese processing plant and other food processing plants are in Perham.

There are six airports in the county. The Battle Lake, Henning, New York Mills, and Pelican Rapids airports have grassed runways. The airports in the cities of Fergus Falls and Perham have paved runways.

Physiography, Relief, and Drainage

Inspiration Peak, the highest elevation in Otter Tail County, is approximately 1,720 feet above sea level. It is on the Alexandria Moraine Complex in the southeastern part of the county, west of Urbank. The lowest point in the county is at an elevation of approximately 1,010 feet above sea level where the Otter Tail River exits the southwest corner of the county.

The county can be divided into five broadly defined landform regions. These are the stagnation moraines, till plains, Wadena Drumlin Field, pitted outwash plains, and Glacial Lake Agassiz Lake Plain. The location of these landform areas within the county is illustrated in figure 2.

The areas of stagnation moraine are comprised of geomorphic regions of the Alexandria Moraine Complex and Big Stone Moraine Complex, which make up about 35 percent of the county. The topography of the stagnation moraine associated with the Alexandria Moraine Complex has high relief with differences in elevation ranging from 10 to 120 feet. The area is gently undulating to steep and is characterized by wet depressions, marshes, and numerous small to large lakes. The stagnation moraine associated with the Big Stone Moraine Complex has undulating to hilly topography with lower relief. The differences in elevation commonly range from 10 to 50

feet. This moraine has wet depressions, marshes, and a few small lakes. Attempts have been made to drain the wet depressions within the moraines, but the complex landscape and a lack of drainage outlets have hindered these practices.

In the northeastern part of the county is the Wadena Drumlin Field, which makes up about 6 percent of the county. The topography is dominated by gently sloping to strongly sloping landscapes of moderate relief. The local relief generally ranges from a few feet to about 30 feet. Many of the depressions between the drumlins are commonly drained by shallow drainageways or deeper drainage ditches. The ditches and drainageways remove the excess surface water.

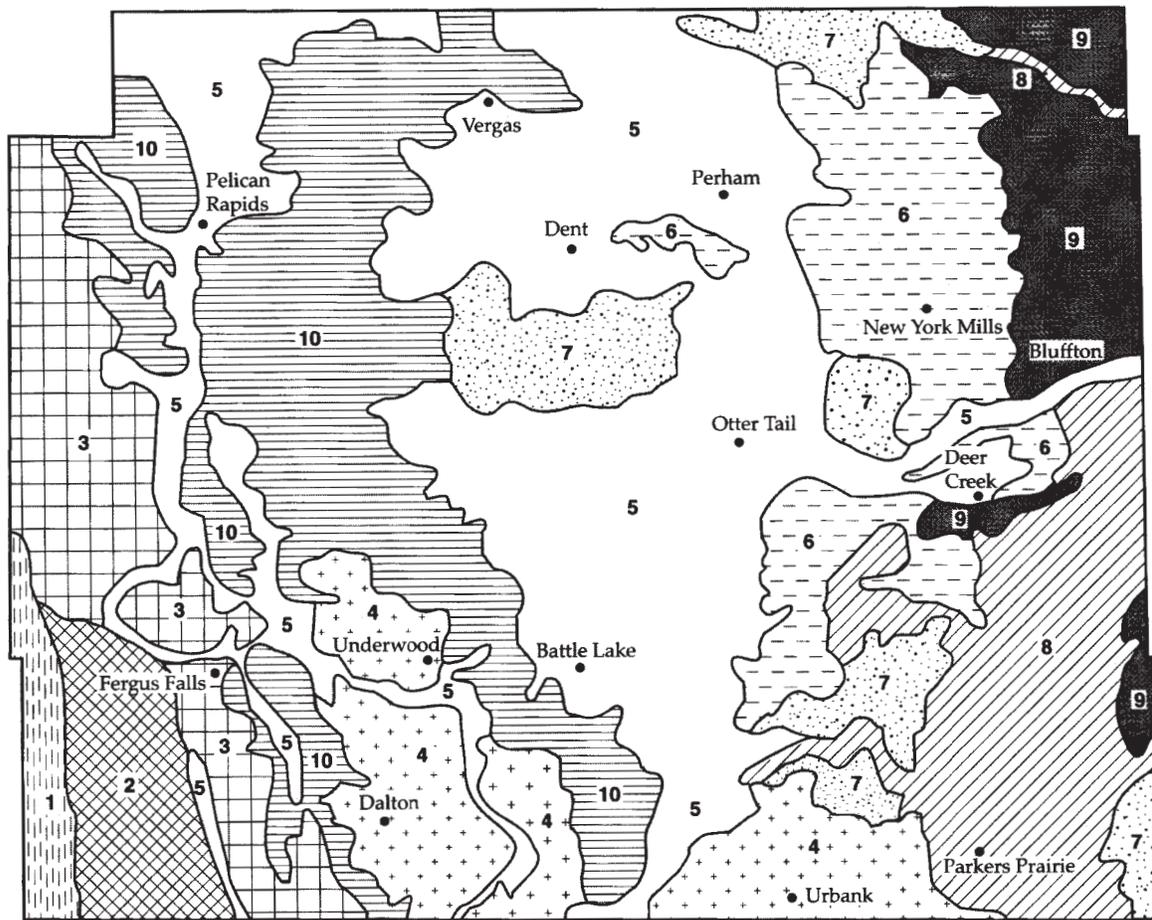
The Henning and Fergus Falls till plains make up 18 percent of the county. The topography is dominated by nearly level to hilly landscapes with short slopes. These areas have moderate relief with differences in elevation commonly ranging from 5 to 50 feet.

The Detroit Lakes Pitted Outwash Plain in the central part of the county and along the meltwater channel of the Pelican River and the Park Rapids-Staples Outwash Plain in the southeast corner of the county make up 40 percent of the county. The topography of the outwash plain areas is nearly level to hilly and has low or moderate relief. The differences in elevation typically range from a few feet to about 40 feet. The Detroit Lakes Pitted Outwash Plain commonly has small to large lakes and small wet depressions. The Park Rapids-Staples Outwash Plain has less relief. It has fewer lakes than other areas but contains more and larger wet depressions, which result from the shallower surficial ground-water table. Many of the large depressions have been drained by ditches that outlet into tributaries of the Leaf River or the Wing River.

The Glacial Lake Agassiz Lake Plain in the southwest corner of the county makes up approximately 1 percent of the county. The area typically is flat or nearly level but ranges to gently sloping in the vicinities of the glacial beach ridges. This area contains a few drainage ditches, and almost all of the soils have some form of surface drainage. The area also has some small and medium depressions.

The continental divide that separates north-flowing waters from south-flowing waters lies in an irregular line near Butler to New York Mills, then south towards Urbank, northwest towards Underwood, and finally south to just west of Dalton. North-flowing waters drain via the Red River into the Hudson Bay, and south-flowing waters drain via the Crow Wing and Minnesota Rivers into the Mississippi River.

Nearly 60 percent of the surface water in Otter Tail



Adapted from the Geologic Map of Minnesota, Quaternary

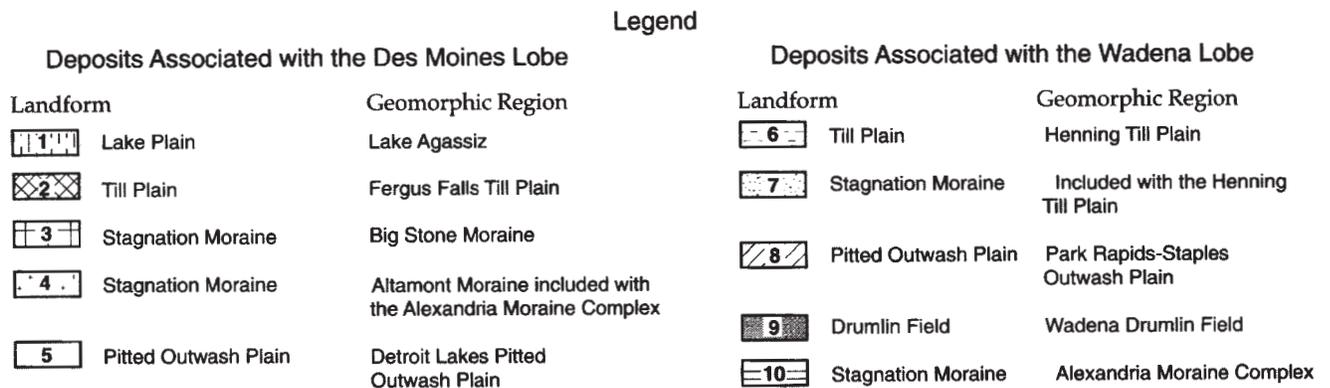


Figure 2.—Geomorphology and parent material of Otter Tail County.

County flows south and west into the Otter Tail River. The Otter Tail River enters the county from Becker County just south of the city of Frazee. A chain of lakes, including Little Pine Lake, Big Pine Lake, Otter Tail Lake, Rush Lake, and Lost Lake, are connected

by the Otter Tail River. The river contains a number of low head dams that maintain water levels and control flooding. The Otter Tail River flows through Fergus Falls and enters the Glacial Lake Agassiz basin near the Orwell Reservoir. It then flows west through Wilkin

County into the Red River. The Toad River drains to the south from Becker County and empties into Big Pine Lake. The Dead River drains Dead Lake towards Otter Tail Lake. The Pelican River drains to the south from Prairie Lake through Pelican Rapids and enters the Otter Tail River west of Fergus Falls. The Pomme de Terre River in the southwestern part of the county is a tributary of the Minnesota River. It flows west from Stalker Lake and then drains into Ten Mile Lake and south into Grant County. The Wing River drains the southeastern part of the county, the Leaf River drains the east-central part, and the Redeye River drains the northeastern part. These rivers and their tributaries flow eastward into the Crow Wing River and the Mississippi River.

Geologic History and Geomorphology

Continental glaciation formed the landscapes of Otter Tail County. Bedrock in Otter Tail County is covered by 200 to more than 400 feet of Wisconsin glacial deposits. Glaciers moving as lobate rivers of ice advanced across the survey area many times and from several different directions. The present landscapes of Otter Tail County began to take shape during the early and middle parts of the Wisconsin Glaciation. The geomorphic landforms in Otter Tail County are drumlin fields, stagnation moraines, till plains, pitted outwash plains, kame moraines, and glacial lake plains (Hobbs and Goebel, 1982).

The Wadena Drumlin Field fans out across Wadena, Todd, Cass, Hubbard, Becker, and Otter Tail Counties of Minnesota. This geomorphic area represents the oldest landscape in Otter Tail County. Radiocarbon dating of organic silts and lake sediments suggests that the drumlins are about 30,000 to 60,000 years old (Wright, 1972). In Otter Tail County, the drumlins are in the northeast corner and near the Todd and Wadena County lines south of the Leaf River. The Wadena Drumlin Field consists of a series of low, smooth, elongated oval hills and broad, nearly level depressions that are oriented from east to west.

The fanlike shape of the drumlin field suggests that ice moved from the northeast. There are two main theories regarding the formation of the drumlins. Studies of pebble lithology and carbonate content suggest that glacial till moved southeastward from the Winnipeg Lowlands into northern Minnesota. This movement was diverted by another glacial lobe advancing from the east (Wright, 1962). A more recent study, however, suggests that pre-late Wisconsin glacial ice that advanced from the Keewatin ice center that is now called the Winnipeg Lobe (formerly

identified as the Wadena Lobe) was laid down before the drumlins by an older Rainy Lobe source from the northeast. Thus the Wadena Drumlin Field resulted from a progressive mixing of glacial till from a northeastern source, and ice lobes and flows molded the drumlins (Goldstein, 1985).

When the Wadena or Winnipeg Lobe advanced from the east and northeast across the county, it formed the core of the Alexandria Moraine and the Wadena Drumlin Field. Later readvances of the Wadena Lobe occurred about 20,000 years ago. The coarse-loamy till of the Wadena or Winnipeg Lobe is characterized by less than 18 percent clay and more than 50 percent sand (Anderson, 1976).

The Alexandria Moraine Complex consists of stagnation moraines. These stagnation moraines formed at the outer edges of a glacial lobe. There are also some smaller areas of stagnation moraine in the eastern half of the county. Stagnation moraine landscapes have a complicated pattern of soil materials. Although they are mostly made up of glacial till, some are local deposits of outwash and water-laid sediments. The moraines are typically the highest in elevation, have the greatest relief, and are commonly hilly. There are many small to large ice-block basins in stagnation moraines that now contain lakes or marshes. Ice-walled lakes formed when pits in the stagnant ice on the Alexandria Moraine filled with water-laid sediments. Later, as the ice melted, the surrounding landscape collapsed and the lake bottom became what is now the hilltop (Clayton and Cherry, 1967).

The stagnation moraines in Otter Tail County were formed by ice advances from both the Wadena or Winnipeg Lobe and the Des Moines Lobe.

The Altamont Moraine in Otter Tail County is the portion of the Alexandria Moraine that was overridden by the Des Moines Lobe glacial drift.

About 14,000 years ago, the Des Moines Lobe advanced to the south across Manitoba, where it incorporated limestone rocks. As the glacial lobe moved south along the Red River Lowland, shale-rich materials derived from Cretaceous rock were mixed into the till fabric (Sachreiter, 1975). The Des Moines Lobe continued to spread east into Otter Tail County onto the Alexandria Moraine and southeast along the moraine. Before it retreated, the Des Moines Lobe left behind the Big Stone Moraine, which is also referred to as the Fergus Falls Till Plain (University of Minnesota, 1969). The fine-loamy till of the Des Moines Lobe is characterized by more than 18 percent clay, typically less than 50 percent sand, and a high content of shale.

The Henning Till Plain was formed behind the

advancing front of the glacial ice of the Wadena or Winnipeg Lobe and the Des Moines Lobe. The till plain has generally low or moderate relief and is typically gently undulating. In places, especially south and west of New York Mills, the till was deposited over older outwash deposits. Thus, in some areas on the Henning Till Plain, the till ranges from about 3 feet to more than 10 feet thick over outwash. Also on the till plain, glacial meltwaters flowing under the ice of the Wadena Lobe formed a few eskers.

The large volumes of meltwater pouring east and south off the Wadena and Des Moines Lobes left extensive outwash plains. This outwash area formed the Detroit Lakes Pitted Outwash Plain in the central part of the county. Pitted outwash plains are characterized by many small to large ice-block basins that now contain lakes or marshes. The areas of the Detroit Lakes Pitted Outwash Plain adjacent to the Alexandria Moraine are described as kame moraines in the county. The landforms and topography of the kame moraine are similar to those of the stagnation moraine, except that the parent material is outwash.

Meltwater sediments flowing eastward from the Henning Till Plain and southward from the Itasca Moraine Complex formed the Park Rapids-Staples Outwash Plain. The Redeye and Leaf Rivers were major meltwater channels flowing eastward. Water flowage was blocked in an area near Pillager, resulting in the formation of Glacial Lake Wadena. Meltwater and sediment were redirected along a meltwater channel toward Parkers Prairie. Eventually the blockage at the Pillager gap was broken, and meltwaters from the Des Moines and Wadena Lobes exited eastward through the gap into the Crow Wing River.

About 9,000 to 12,000 years ago, tremendous volumes of meltwater accumulated to form Glacial Lake Agassiz. Lake Agassiz was more than 360 feet deep and covered more than 120,000 square miles in Minnesota, North Dakota, and Canada. It was formed when the normal northward flow of water in the Red River Valley was blocked by the Des Moines glacial ice lobe. As water levels rose higher, Glacial Lake Agassiz developed an outlet to the south near Browns Valley. A succession of beach ridges formed, marking stable lake levels. The Herman Beach marks the highest stable level of Lake Agassiz. It runs along the eastern edge of the Lake Agassiz Plain in Otter Tail County. When the Des Moines glacial lobe retreated, the water in the Red River Valley could once again flow north and Lake Agassiz drained away (Elson, 1967).

The most recent deposits in the survey area are not glacial in origin. They consist of alluvial sediments on

flood plains and lakeshores. Organic material and limnic sediments in lakes and depressions are estimated to have accumulated about 4,000 to 5,000 years ago (Norton, 1982).

Climate

The three tables at the end of this section provide climate data for the survey area as recorded at Ottertail and Fergus Falls in the period 1961 to 1990.

In winter, the average temperature at Ottertail and Fergus Falls is 11 degrees F. The average daily minimum temperature is 0 degrees at Ottertail and 1 degree at Fergus Falls. The lowest temperature on record at Ottertail, which occurred on February 3, 1982, is -41 degrees. The lowest temperature on record at Fergus Falls, which occurred on February 5, 1982, is -40 degrees. In summer, the average temperature is 69 degrees at Ottertail and 68 degrees at Fergus Falls. The average daily maximum temperature is 80 degrees at both recording stations. The highest temperature at Ottertail, which occurred on July 27, 1988, is 102 degrees. The highest temperature at Fergus Falls, which occurred on August 16, 1988, also is 102 degrees.

Growing degree days are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation at Ottertail is 26.56 inches. Of this, 19.45 inches, or about 73 percent, usually falls in April through September. The total annual precipitation at Fergus Falls is 23.25 inches. Of this, 17.46 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 4.4 inches at Ottertail on June 19, 1979, and 4.3 inches at Fergus Falls on August 7, 1992. Thunderstorms occur on about 32 days each year, and most occur in July.

The average seasonal snowfall is 49.9 inches at Ottertail and 40.3 inches at Fergus Falls. The greatest snow depth at any one time during the period of record was 34 inches at Ottertail and 27 inches at Fergus Falls. The heaviest 1-day snowfall on record was 14 inches at Ottertail and 12 inches at Fergus Falls.

The average relative humidity in midafternoon is about 62 percent. Humidity is higher at night, and the average at dawn is about 81 percent. The sun shines

67 percent of the time in summer and 50 percent in winter. The prevailing wind is from the south-southeast.

Average windspeed is highest, 14 miles per hour, in April.

Temperature and Precipitation

(Recorded in the period 1961-90 at Ottertail and Fergus Falls, Minnesota)

Month	Temperature						Precipitation					
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days*	Average	2 years in 10 will have--			Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--			
				°F	°F			°F	°F	°F		
OTTERTAIL:												
January----	17.4	-4.0	6.7	45	-36	0	0.93	0.31	1.45	3	11.6	
February----	23.8	1.5	12.6	48	-34	1	.67	.27	1.01	3	8.3	
March-----	36.7	15.9	26.3	64	-22	17	1.38	.74	1.95	4	9.9	
April-----	54.5	31.8	43.1	81	6	166	2.40	1.27	3.54	6	4.5	
May-----	68.7	44.6	56.6	88	25	518	2.99	1.63	4.19	6	.1	
June-----	77.4	54.6	66.0	93	38	775	4.34	2.76	5.77	7	.0	
July-----	82.8	59.8	71.3	97	44	962	3.89	2.12	5.46	6	.0	
August-----	80.3	57.4	68.9	95	40	890	3.34	1.43	4.97	5	.0	
September--	69.7	47.6	58.6	90	28	559	2.49	1.13	3.65	5	.0	
October----	57.3	36.6	46.9	81	18	248	2.25	.68	3.52	4	1.2	
November---	37.7	21.0	29.3	63	-9	26	1.03	.40	1.57	3	7.6	
December---	22.3	3.6	13.0	47	-30	1	.85	.35	1.27	3	9.7	
Yearly:												
Average----	52.4	30.8	41.6	---	---	---	---	---	---	---	---	---
Extreme----	102	-41	---	98	-37	---	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,165	26.58	21.85	31.03	55	52.9	
FERGUS FALLS:												
January----	16.6	-3.4	6.6	44	-31	0	0.73	0.23	1.14	2	11.3	
February----	22.7	2.4	12.6	47	-30	0	.55	.20	.84	2	6.3	
March-----	36.2	17.2	26.7	65	-17	18	1.14	.60	1.62	3	7.4	
April-----	53.8	32.2	43.0	83	9	159	2.06	.73	3.17	4	2.0	
May-----	68.3	44.9	56.6	90	25	499	2.70	1.28	3.92	6	.0	
June-----	76.8	54.3	65.6	94	39	739	3.75	2.15	5.17	6	.0	
July-----	82.2	59.7	70.9	97	45	927	3.35	1.67	4.80	5	.0	
August-----	80.1	56.9	68.5	96	41	854	3.12	1.59	4.45	5	.0	
September--	69.3	46.8	58.1	91	28	521	2.48	1.03	3.71	4	.0	
October----	57.2	35.6	46.4	83	17	224	1.80	.55	2.81	3	.2	
November---	37.5	20.8	29.1	64	-8	24	.91	.30	1.42	2	4.7	
December---	21.5	4.0	12.8	47	-26	1	.66	.23	1.02	2	9.0	
Yearly:												
Average----	51.8	30.9	41.4	---	---	---	---	---	---	---	---	---
Extreme----	102	-40	---	102	-33	---	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,965	23.24	14.88	29.35	44	40.9	

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Ottertail and Fergus Falls, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
OTTERTAIL			
Last freezing temperature in spring:			
1 year in 10 later than--	May 1	May 13	May 21
2 years in 10 later than--	Apr. 26	May 8	May 17
5 years in 10 later than--	Apr. 17	Apr. 29	May 8
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 8	Sept. 26	Sept. 15
2 years in 10 earlier than--	Oct. 13	Oct. 1	Sept. 19
5 years in 10 earlier than--	Oct. 22	Oct. 10	Sept. 28
FERGUS FALLS			
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 28	May 12	May 22
2 years in 10 later than--	Apr. 24	May 7	May 17
5 years in 10 later than--	Apr. 15	Apr. 26	May 7
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 2	Sept. 24	Sept. 14
2 years in 10 earlier than--	Oct. 8	Sept. 29	Sept. 18
5 years in 10 earlier than--	Oct. 17	Oct. 8	Sept. 28

Growing Season

(Recorded in the period 1961-90 at Ottertail and Fergus Falls, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
OTTERTAIL:			
9 years in 10	156	140	126
8 years in 10	163	146	131
5 years in 10	175	158	141
2 years in 10	188	170	151
1 year in 10	194	176	156
FERGUS FALLS:			
9 years in 10	155	138	122
8 years in 10	162	145	129
5 years in 10	175	160	142
2 years in 10	188	175	155
1 year in 10	194	183	161

This page intentionally left blank.

General Soil Map Units

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

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

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

Soils That Formed Dominantly in Loamy Glacial Till and Organic Material Under Dominantly Forested Vegetation

1. Blowers-Paddock-Cathro Association

Setting

Landform and position on the landform: Backslopes and toeslopes on drumlins and depressions between drumlins (fig. 3)

Slope range: 0 to 5 percent

Composition

Percent of the survey area: 6

Extent of the components in the association:

Blowers and similar soils—43 percent

Paddock and similar soils—18 percent

Cathro and similar soils—15 percent

Minor soils—24 percent

Soil Properties and Qualities

Blowers

Drainage class: Moderately well drained

Parent material: Till

Surface texture: Fine sandy loam

Paddock

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Sandy loam

Cathro

Drainage class: Very poorly drained

Parent material: Organic material over glaciolacustrine deposits or till

Surface texture: Muck

Minor Soils

- Pinelake and similar soils
- Epoufette and similar soils
- Oylen and similar soils
- Runeberg and similar soils
- Rockwood and similar soils
- Hillview and similar soils
- Becida and similar soils

Soils That Formed Dominantly in Loamy Glacial Till and Organic Material Under Dominantly Prairie Vegetation

2. Chapett-Sisseton-Friberg Association

Setting

Landform and position on the landform: Backslopes, summits, and swales on moraines (fig. 4)

Slope range: 0 to 30 percent

Composition

Percent of the survey area: 8

Extent of the components in the association:

Chapett and similar soils—52 percent

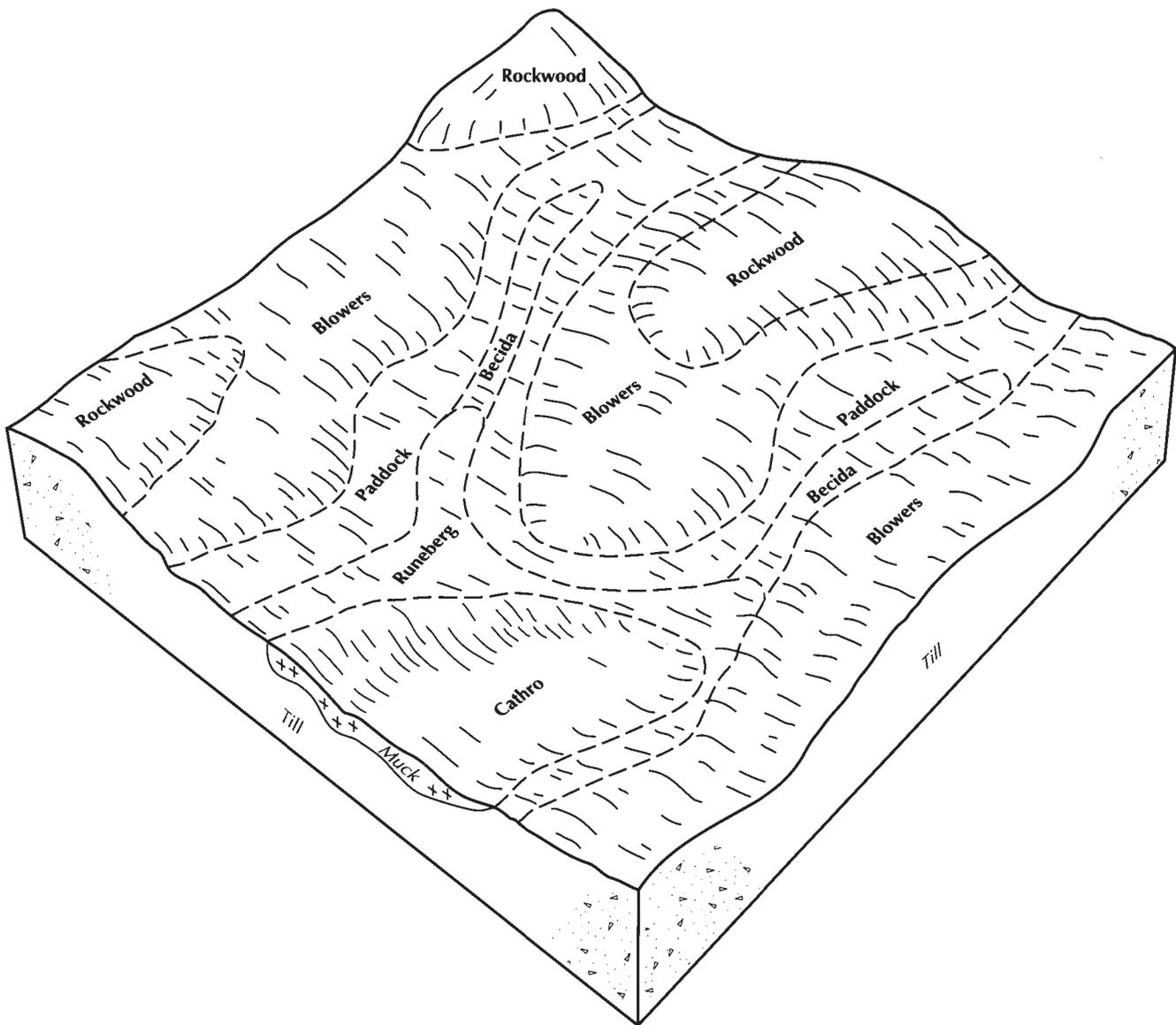


Figure 3.—Typical pattern of soils and parent material in the Blowers-Paddock-Cathro association.

Sisseton and similar soils—17 percent
 Friberg and similar soils—10 percent
 Minor soils—21 percent

Soil Properties and Qualities

Chapett

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Sisseton

Drainage class: Well drained

Parent material: Till
Surface texture: Loam

Friberg

Drainage class: Poorly drained
Parent material: Colluvium over till
Surface texture: Loam

Minor Soils

- Quam and similar soils
- Weetown and similar soils
- Lizzie and similar soils
- Cathro and similar soils

3. Sisseton-Heimdal-Quam Association

Setting

Landform and position on the landform: Backslopes, summits, and depressions on moraines
Slope range: 0 to 30 percent

Composition

Percent of the survey area: 3
Extent of the components in the association:
 Sisseton and similar soils—37 percent
 Heimdal and similar soils—29 percent
 Quam and similar soils—9 percent
 Minor soils—25 percent

Soil Properties and Qualities

Sisseton

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Heimdal

Drainage class: Well drained
Parent material: Till

Surface texture: Loam

Quam

Drainage class: Very poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silt loam

Minor Soils

- Lakepark and similar soils
- Darnen and similar soils
- Arvilla and similar soils
- Sandberg and similar soils

4. Formdale-Aazdahl-Parnell Association

Setting

Landform and position on the landform: Backslopes, summits, swales, toeslopes, and rises on moraines
Slope range: 0 to 20 percent

Composition

Percent of the survey area: 4

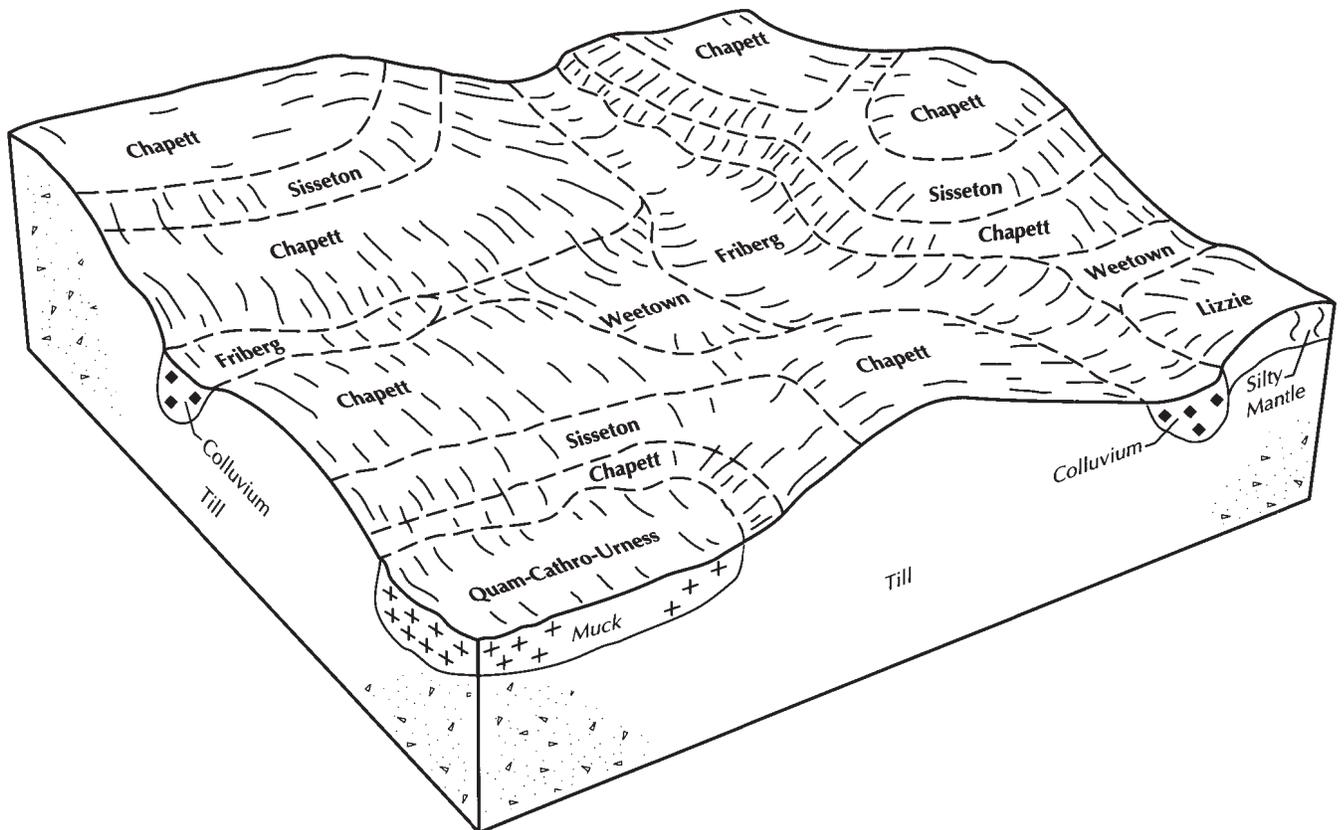


Figure 4.—Typical pattern of soils and parent material in the Chapett-Sisseton-Friberg association.

Extent of the components in the association:

- Formdale and similar soils—32 percent
- Aazdahl and similar soils—26 percent
- Parnell and similar soils—12 percent
- Minor soils—30 percent

Soil Properties and Qualities**Formdale**

Drainage class: Well drained
Parent material: Till
Surface texture: Clay loam

Aazdahl

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Clay loam

Parnell

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silt loam

Minor Soils

- Buse and similar soils
- Hamerly and similar soils
- Roliss and similar soils
- Langhei and similar soils
- Quam and similar soils

5. Barnes-Langhei-Lakepark Association**Setting**

Landform and position on the landform: Backslopes, summits, and swales on moraines (fig. 5)
Slope range: 1 to 20 percent

Composition

Percent of the survey area: 6
Extent of the components in the association:
 Barnes and similar soils—40 percent
 Langhei and similar soils—26 percent
 Lakepark and similar soils—14 percent
 Minor soils—20 percent

Soil Properties and Qualities**Barnes**

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Langhei

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Lakepark

Drainage class: Poorly drained
Parent material: Colluvium over till
Surface texture: Loam

Minor Soils

- Darnen and similar soils
- Hamerly and similar soils
- Rothsay and similar soils
- Buse and similar soils
- Quam and similar soils

Soils That Formed Dominantly in Loamy Glacial Till and Sandy Glacial Outwash Under Dominantly Forested Vegetation**6. Snellman-Naytahwaush-Lida Association****Setting**

Landform and position on the landform: Backslopes and summits on moraines (fig. 6)
Slope range: 1 to 45 percent

Composition

Percent of the survey area: 11
Extent of the components in the association:
 Snellman and similar soils—53 percent
 Naytahwaush and similar soils—13 percent
 Lida and similar soils—8 percent
 Minor soils—26 percent

Soil Properties and Qualities**Snellman**

Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam

Naytahwaush

Drainage class: Well drained
Parent material: Till
Surface texture: Clay loam

Lida

Drainage class: Well drained

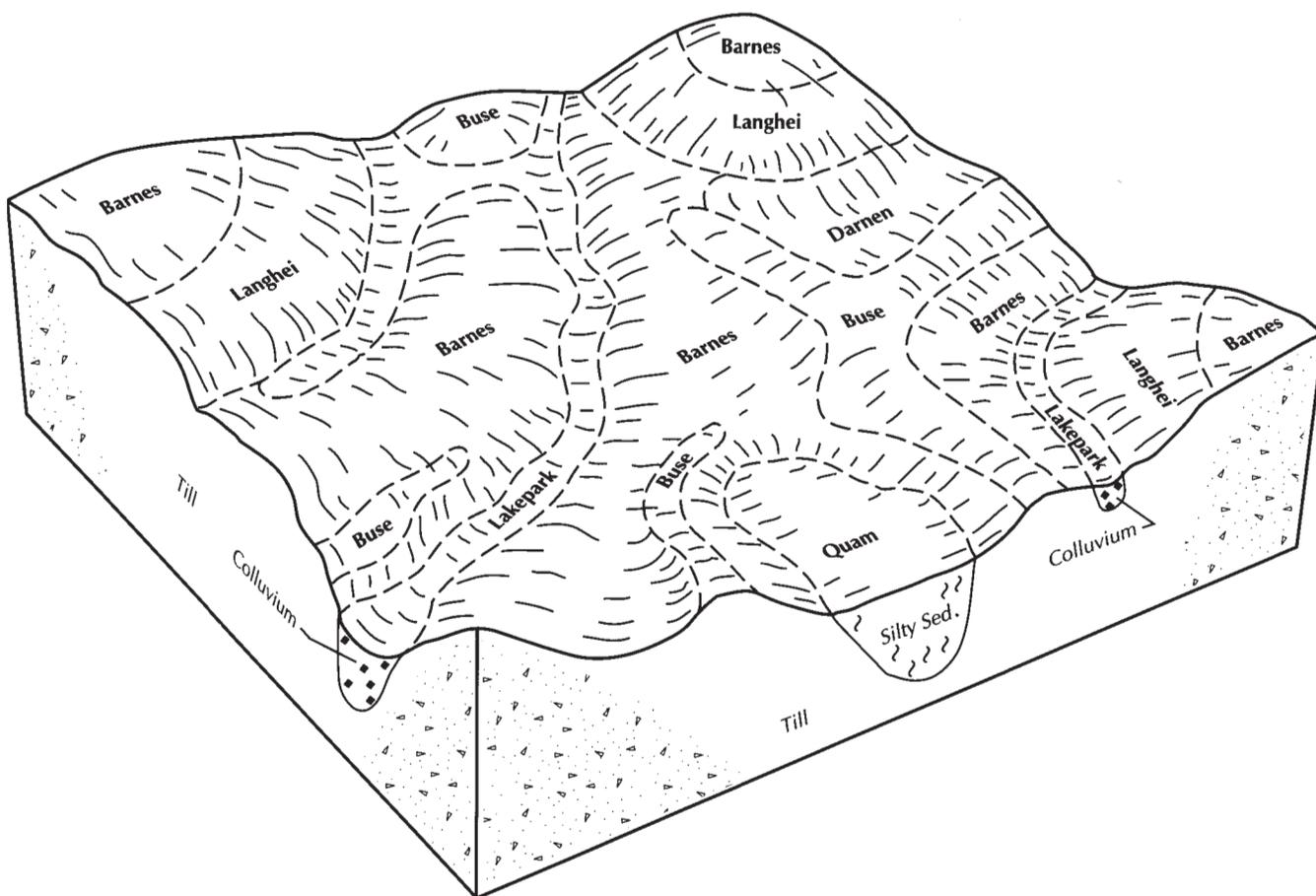


Figure 5.—Typical pattern of soils and parent material in the Barnes-Langhei-Lakepark association.

Parent material: Glacial outwash
Surface texture: Sandy loam

Slope range: 2 to 20 percent

Minor Soils

- Mahkonce and similar soils
- Knute and similar soils
- Cathro and similar soils
- Brandsvold and similar soils
- Seelyeville and similar soils
- Egglake and similar soils

Composition

Percent of the survey area: 6
Extent of the components in the association:
 Forman and similar soils—36 percent
 Buse and similar soils—16 percent
 Peever and similar soils—15 percent
 Minor soils—33 percent

Soils That Formed Dominantly in Loamy Glacial Till and Organic Material Under Mixed Prairie and Forested Vegetation

Soil Properties and Qualities

7. Forman-Buse-Peever Association

Forman

Drainage class: Well drained
Parent material: Till
Surface texture: Clay loam

Setting

Landform and position on the landform: Backslopes and summits on moraines (fig. 7)

Buse

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

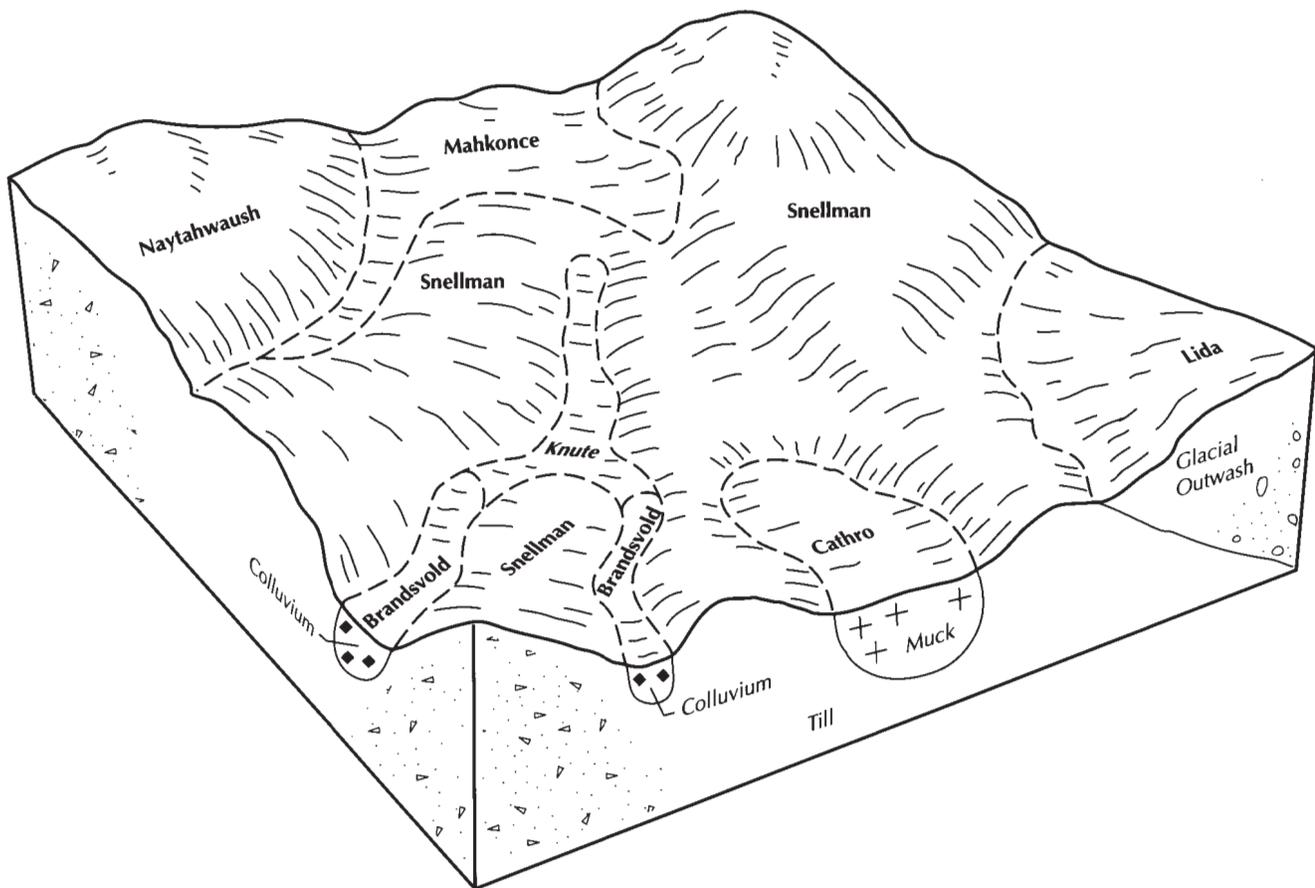


Figure 6.—Typical pattern of soils and parent material in the Snellman-Naytahwaush-Lida association.

Peever

Drainage class: Well drained
Parent material: Till
Surface texture: Clay loam

Minor Soils

- Mehurin and similar soils
- Parnell and similar soils
- Gonvick and similar soils
- Parnell, depressional, and similar soils
- Cathro and similar soils

8. Kandota-Knute-Brandsvold Association

Setting

Landform and position on the landform: Backslopes, toeslopes, and swales on moraines (fig. 8)
Slope range: 0 to 20 percent

Composition

Percent of the survey area: 12
Extent of the components in the association:
 Kandota and similar soils—57 percent
 Knute and similar soils—18 percent
 Brandsvold and similar soils—9 percent
 Minor soils—16 percent

Soil Properties and Qualities

Kandota

Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam

Knute

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Fine sandy loam

Brandsvold

Drainage class: Poorly drained
Parent material: Till
Surface texture: Fine sandy loam

Minor Soils

- Cathro and similar soils
- Lida and similar soils
- Nitché and similar soils
- Clitherall and similar soils
- Pinelake, till substratum, and similar soils
- Bluffton and similar soils
- Leaflake and similar soils

Composition

Percent of the survey area: 4
Extent of the components in the association:
 Waukon and similar soils—55 percent
 Cathro and similar soils—15 percent
 Gonvick and similar soils—10 percent
 Minor soils—20 percent

Soil Properties and Qualities

Waukon

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Cathro

Drainage class: Very poorly drained
Parent material: Organic material over glaciolacustrine deposits or till
Surface texture: Muck

Gonvick

Drainage class: Moderately well drained

9. Waukon-Cathro-Gonvick Association

Setting

Landform and position on the landform: Backslopes, summits, depressions, swales, toeslopes, and footslopes on moraines (fig. 9)
Slope range: 0 to 30 percent

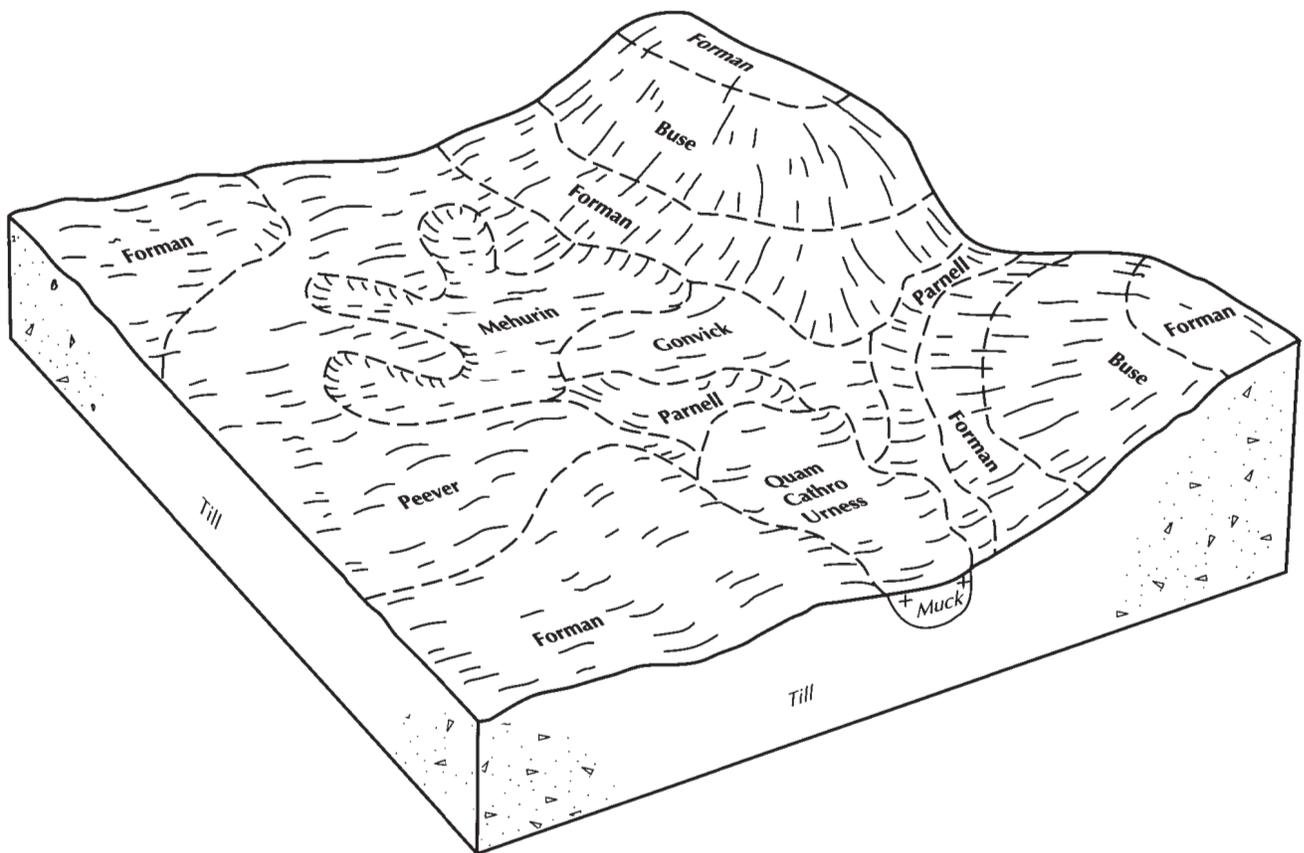


Figure 7.—Typical pattern of soils and parent material in the Forman-Buse-Peever association.

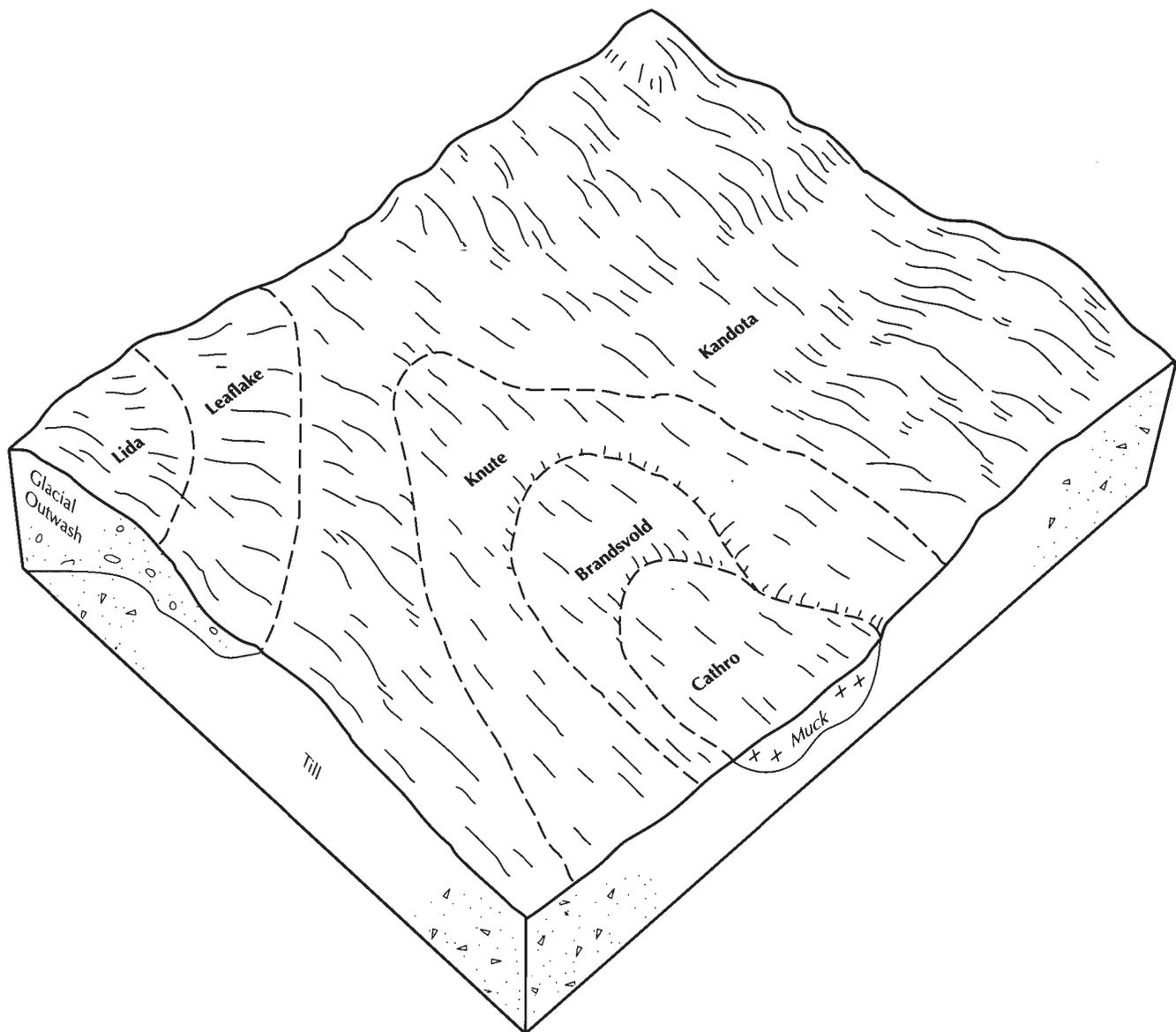


Figure 8.—Typical pattern of soils and parent material in the Kandota-Knute-Brandsvold association.

Parent material: Till
Surface texture: Loam

Minor Soils

- Parnell and similar soils
- Naytahwaush and similar soils
- Parnell, depressional, and similar soils
- Bygland and similar soils

Soils That Formed Dominantly in Organic Material and Sandy Glacial Outwash

Under Mixed Forested and Prairie Vegetation

10. Nidaros-Seelyeville-Pinelake Association

Setting

Landform and position on the landform: Depressions, flats, and rises on outwash plains
Slope range: 0 to 2 percent

Composition

Percent of the survey area: 1

Extent of the components in the association:

- Nidaros and similar soils—37 percent
- Seelyeville and similar soils—24 percent
- Pinelake and similar soils—21 percent
- Minor soils—18 percent

Soil Properties and Qualities

Nidaros

Drainage class: Very poorly drained
Parent material: Organic materials over glacial outwash
Surface texture: Muck

Seelyeville

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

Pinelake

Drainage class: Poorly drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- Isan and similar soils
- Epoufette and similar soils
- Meehan and similar soils
- Eagleview and similar soils
- Oylen and similar soils



Figure 9.—An area of the Waukon-Cathro-Gonvick association. Water erosion is a management concern in the more sloping areas, and the depth to the water table is a concern in the nearly level or concave areas.

Soils That Formed Dominantly in Sandy Glacial Outwash and Organic Material Under Dominantly Prairie Vegetation

11. Hubbard-Duelm-Nidaros Association

Setting

Landform and position on the landform: Backslopes, rises, flats, and depressions on outwash plains
Slope range: 0 to 12 percent

Composition

Percent of the survey area: 3
Extent of the components in the association:
 Hubbard and similar soils—77 percent
 Duelm and similar soils—6 percent
 Nidaros and similar soils—2 percent
 Minor soils—15 percent

Soil Properties and Qualities

Hubbard

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Duelm

Drainage class: Moderately well drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Nidaros

Drainage class: Very poorly drained
Parent material: Organic materials over glacial outwash
Surface texture: Muck

Minor Soils

- Forada and similar soils
- Isan and similar soils
- Sverdrup and similar soils
- Verndale and similar soils
- Clontarf and similar soils
- Oylen and similar soils

12. Dorset-Corliss-Nidaros Association

Setting

Landform and position on the landform: Summits, backslopes, and depressions on outwash plains (fig. 10)
Slope range: 0 to 35 percent

Composition

Percent of the survey area: 13
Extent of the components in the association:
 Dorset and similar soils—53 percent
 Corliss and similar soils—16 percent
 Nidaros and similar soils—8 percent
 Minor soils—23 percent

Soil Properties and Qualities

Dorset

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Corliss

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Nidaros

Drainage class: Very poorly drained
Parent material: Organic materials over glacial outwash
Surface texture: Muck

Minor Soils

- Oylen and similar soils
- Pinelake and similar soils
- Nitche and similar soils
- Almora and similar soils

13. Arvilla-Sverdrup-Sandberg Association

Setting

Landform and position on the landform: Flats, rises, and backslopes on outwash plains (fig. 11)
Slope range: 0 to 20 percent

Composition

Percent of the survey area: 12
Extent of the components in the association:
 Arvilla and similar soils—34 percent
 Sverdrup and similar soils—24 percent
 Sandberg and similar soils—20 percent
 Minor soils—22 percent

Soil Properties and Qualities

Arvilla

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash

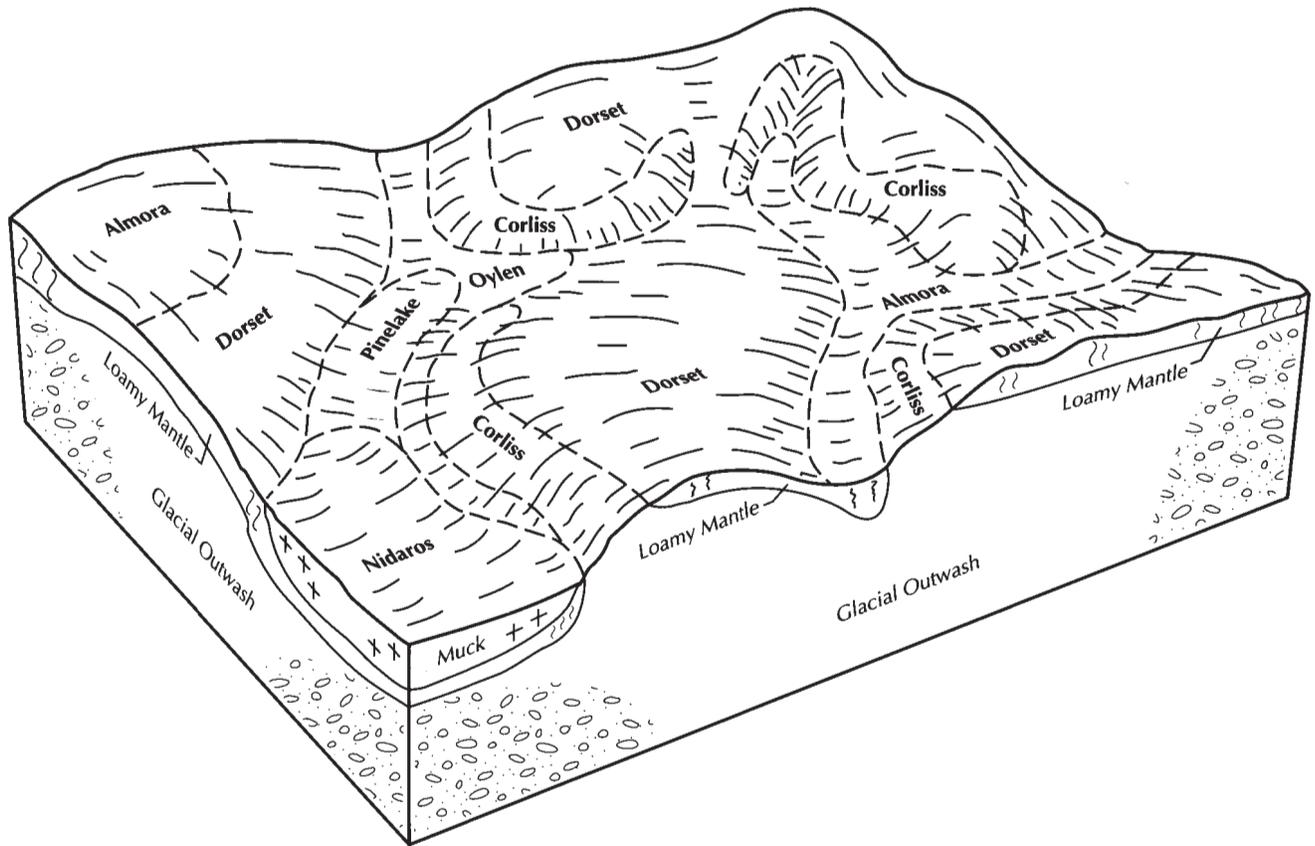


Figure 10.—Typical pattern of soils and parent material in the Dorset-Corliss-Nidaros association.

Surface texture: Sandy loam

Sverdrup

Drainage class: Well drained

Parent material: Glacial outwash

Surface texture: Sandy loam

Sandberg

Drainage class: Excessively drained

Parent material: Glacial outwash

Surface texture: Loamy sand

Minor Soils

- Fordville and similar soils
- Clontarf and similar soils
- Oylen and similar soils
- Corliss and similar soils
- Forada and similar soils
- Nidaros and similar soils

Soils That Formed Dominantly in Sandy Glacial Outwash and Organic Material Under Dominantly Forested Vegetation

14. Bluffcreek-Nidaros-Epoufette Association

Setting

Landform and position on the landform: Swales, flats, depressions, and rises on outwash plains

Slope range: 0 to 3 percent

Composition

Percent of the survey area: 3

Extent of the components in the association:

Bluffcreek and similar soils—27 percent

Nidaros and similar soils—16 percent

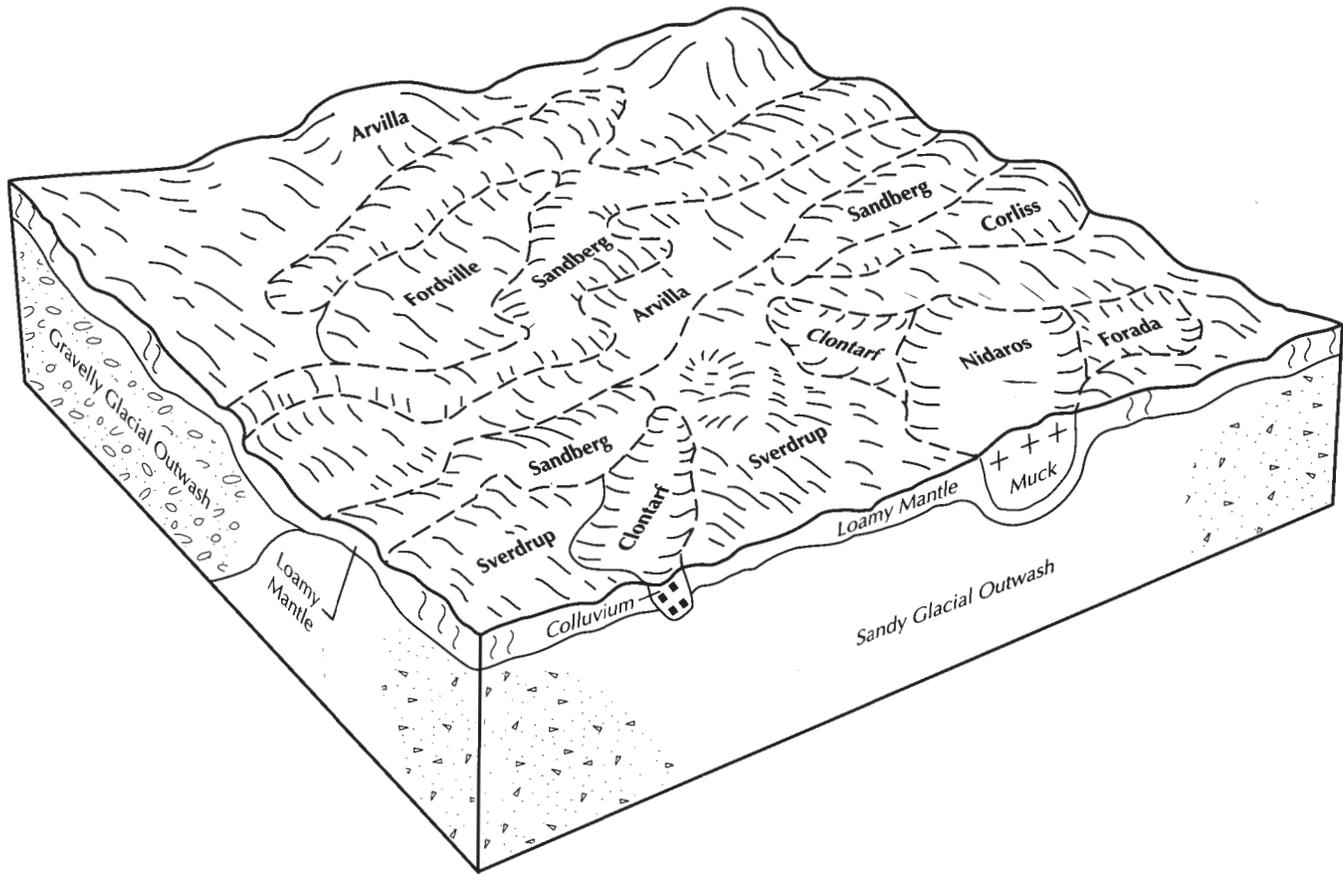


Figure 11.—Typical pattern of soils and parent material in the Arvilla-Sverdrup-Sandberg association.

Epoufette and similar soils—14 percent
 Minor soils—43 percent

Soil Properties and Qualities

Bluffcreek

Drainage class: Moderately well drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Nidaros

Drainage class: Very poorly drained
Parent material: Organic materials over outwash
Surface texture: Muck

Epoufette

Drainage class: Poorly drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- Seelyeville and similar soils
- Lida and similar soils
- Eagleview and similar soils
- Clearriver and similar soils

15. Lida-Two Inlets-Nidaros Association

Setting

Landform and position on the landform: Backslopes, summits, and depressions on outwash plains and kame moraines (fig. 12)
Slope range: 0 to 50 percent

Composition

Percent of the survey area: 6
Extent of the components in the association:
 Lida and similar soils—45 percent

Two Inlets and similar soils—30 percent
 Nidaros and similar soils—10 percent
 Minor soils—15 percent

Soil Properties and Qualities

Lida

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Two Inlets

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Nidaros

Drainage class: Very poorly drained
Parent material: Organic materials over outwash
Surface texture: Muck

Minor Soils

- Epoufette and similar soils
- Bluffcreek and similar soils

- Almora and similar soils

Soils That Formed Dominantly in Loamy Glacial Till and Sandy, Loamy, and Silty Glaciolacustrine Sediments Under Dominantly Prairie Vegetation

16. Hamerly-Rockwell-Mustinka Association

Setting

Landform and position on the landform: Flats, rises, and swales on lake plains
Slope range: 0 to 4 percent

Composition

Percent of the survey area: 1
Extent of the components in the association:
 Hamerly and similar soils—33 percent
 Rockwell and similar soils—19 percent
 Mustinka and similar soils—13 percent
 Minor soils—35 percent

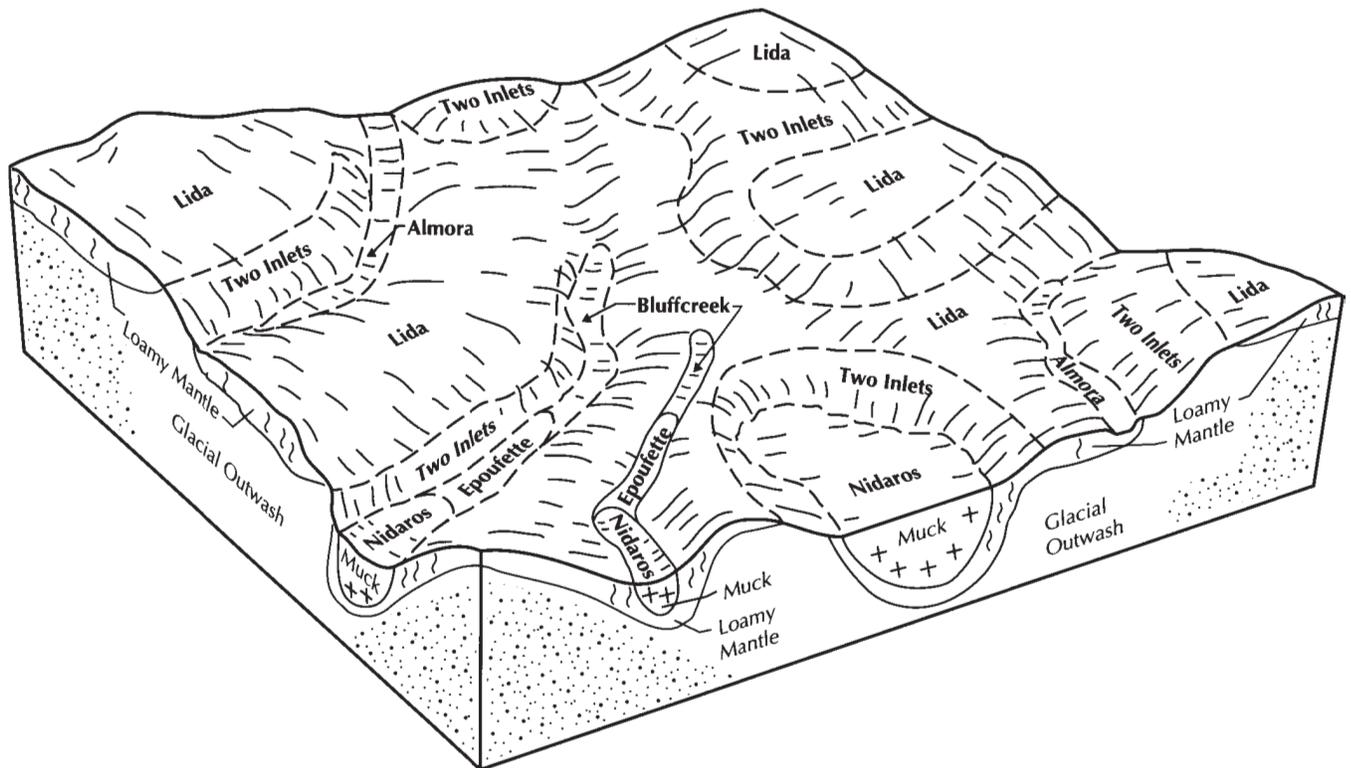


Figure 12.—Typical pattern of soils and parent material in the Lida-Two Inlets-Nidaros association.

Soil Properties and Qualities

Hamerly

Drainage class: Somewhat poorly drained

Parent material: Till

Surface texture: Clay loam

Rockwell

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Loam

Mustinka

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Silty clay loam

Minor Soils

- Roliss and similar soils
- Swenoda and similar soils
- Kittson and similar soils
- Sandberg and similar soils
- Doran and similar soils

17. Rockwell-Wolverton-Foldahl Association

Setting

Landform and position on the landform: Flats, rises, and swales on lake plains

Slope range: 0 to 3 percent

Composition

Percent of the survey area: 1

Extent of the components in the association:

Rockwell and similar soils—30 percent

Wolverton and similar soils—25 percent

Foldahl and similar soils—15 percent

Minor soils—30 percent

Soil Properties and Qualities

Rockwell

Drainage class: Poorly drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Loam

Wolverton

Drainage class: Moderately well drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Very fine sandy loam

Foldahl

Drainage class: Moderately well drained

Parent material: Glaciolacustrine deposits over till

Surface texture: Loamy fine sand

Minor Soils

- Hamerly and similar soils
- Arveson and similar soils
- Sandberg and similar soils
- Grimstad and similar soils
- Winger and similar soils

Formation and Classification of the Soils

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

Formation of the Soils

Soil is a natural body produced by the action of soil-forming processes on materials deposited or accumulated by geologic forces. Soils form through complex processes that can be grouped into four general categories. These are additions, removals, transfers, and transformations. These processes affect soil formation in differing degrees.

The accumulation of organic matter in the surface layer of the mineral soils is an example of an addition. This accumulation is the main reason for the dark color of the surface layer.

The leaching of calcium carbonate from the upper 1 to 4 feet in many of the soils in the county is an example of removal. Initially the parent material of these soils had calcium carbonate throughout, but the calcium carbonate has been moved down from the upper part of the soil profile by percolating water.

The translocation of clay from the surface layer or subsurface layer into the subsoil of the forested soils in the county is an example of a transfer. The surface and subsurface layers are zones of eluviation, or loss. The subsoil is a zone of illuviation, or gain. The subsoil has more clay than the parent material initially had. Thin clay films are in pores and on the faces of peds in the subsoil.

An example of a transformation is the reduction of iron. This process takes place under wet, saturated conditions in which there is no oxygen. Gleying, or iron depletion, is evident in the Bluffton, Forada, and Parnell soils, which have a dominantly gray subsoil. Reduced iron is soluble. It commonly has been moved short distances in the soils. Part of this iron can be reoxidized and segregated in the form of iron concentrations or concretions.

The soil-forming processes and the physical and chemical features of the soil in a given area are influenced by the composition of the parent material, the climate under which the soil material accumulated, the plant and animal life on and in the soil, the relief or

topography, and the length of time that the forces of soil formation have acted on the soil material (Jenny, 1941). All of these factors of soil formation are interrelated. The interaction between one or more of the factors can influence the physical or chemical makeup of the soil. The following paragraphs describe the five major factors of soil formation.

Climate

Otter Tail County has a cool, subhumid, continental climate characterized by cold winters and hot summers. Water from melting snow and rainfall dissolves minerals and supports biological activity. Water transports minerals and organic residues into and across the soil. Temperature influences the kinds and growth rates of plants and animals in and on the soil. The rates of physical and chemical weathering of soil are also controlled by temperature. Freezing of the soil during the winter slows the soil-forming processes. The alternate freezing and thawing disintegrate the parent material, and frost heaving helps to mix the soil material. Rainfall can influence the downward or upward movement of calcium carbonate in the soil.

Climate was responsible for the types of vegetation under which the soils formed. Prairie vegetation enhanced the accumulation of organic matter in the soils, but less organic matter accumulated under forest vegetation.

Living Organisms

The native vegetation of Otter Tail County is grouped into five major types. The western one-third of the county was dominated by prairies. Forests of aspen-birch-conifer were in the northeastern part of the county. Between the prairie and pine forests are the hardwood forests of maple-basswood-oak and savannas of scattered bur oak or brush and grass. Throughout the county the lower lying areas are dominated by wetland vegetation. In the western part of the county, wetlands were dominantly marshes of cattails and sedges. In the eastern part of the county, the wetlands were dominated by tamarack and black ash. Fire was a major influence on the distribution of the vegetation types. Fires fashioned the prairies and the savannas. Fires were more prevalent on the

droughty outwash soils, which promoted prairie and savanna vegetation, than in forested areas. Areas characterized by lower evapotranspiration and soils with a greater water-holding capacity favored forest vegetation (Heinselman, 1974).

All forms of life, both in and on the soil, influence the chemical, physical, and biological processes associated with soil formation. Bacteria, earthworms, and other forms of animal life aid in the weathering of materials, the transformation processes, and the decomposition of organic matter. Also, earthworms and small burrowing animals help to mix soil materials in the surface layer and subsoil. Plants, including fungi, influence soil formation by returning decaying plant residue to the soil and furthering decomposition. Plant roots loosen the soil and bring minerals up from the parent material. Vegetation influences soil structure and the movement of nutrients up and down through the soil. Generally, plants have a greater influence than animals on soil formation.

Human activities also influence soil formation. Farming and land clearing practices increase the intensity of some soil-forming processes. Accelerated erosion of the surface layer has occurred in unprotected areas of farmland. Such activities as altering drainage conditions, maintaining fertility, changing vegetation, and altering runoff and the infiltration of water continue to have an important effect on soil formation.

Topography

Topography is an important factor in soil formation because it affects drainage, aeration, and erosion. Differences in topography can account for the formation of different soils from the same parent material. Topography influences runoff and drainage conditions that can affect types of vegetation and chemical changes taking place on or in the soil. Runoff reduces the amount of water that can leach the soil and be used by plants. Uncontrolled runoff causes erosion.

Soil drainage classes can be related to the position of the soil on the landscape. For example, the positions of Kandota, Knute, Brandsvold, and Bluffton soils, which occur on the Henning Till Plain, are generally predictable. Each soil occupies a particular landscape position. The well drained Kandota soils are on convex, gently sloping to moderately steep backslopes; the moderately well drained Knute soils are on plane, gently sloping footslopes and toeslopes; the poorly drained Brandsvold soils are in nearly level, plane and slightly concave positions on toeslopes and head slopes and in shallow drainageways; and the very poorly drained Bluffton soils are in

depressions and the more concave drainageways. In Otter Tail County, relief ranges from level to very steep.

Parent Material

The parent materials of most of the soils in Otter Tail County were directly or indirectly derived from a series of glaciers that spread across the county and later melted. Glacial till, glacial outwash, and glaciolacustrine deposits are general terms used to characterize the type and origin of the parent materials and the associated geomorphic area where the parent materials occur.

As different glaciers advanced across the land, rocks, clay, silt, and sand were transported and deposited by the glacial ice, by the melting ice, or from meltwaters flowing from the ice. The physical and chemical properties of the parent material were acquired from areas over which the glacial ice advanced.

About 60 percent of the soils in the county formed in glacial till, 36 percent in glacial outwash, 2 percent in glaciolacustrine deposits, and 2 percent in organic material, dominantly herbaceous plants. The parent materials are generally associated with a distinct geomorphic area.

The two main types of glacial till in the county are characterized by the percent of clay, sand, and silt; soil reaction; and type of stones making up the till fabric. The tills are separated into two main groups. Tills that have less than 18 percent clay are generally called the Wadena Lobe or Winnipeg Lobe Till. Till that contains more than 18 percent clay is recognized as the Des Moines Lobe Till (Hobbs and Goebel, 1982).

The parent material on the Henning Till Plain is dominantly Wadena Lobe Till. Brandsvold, Kandota, and Knute soils are the major soils that formed in this till. Clitherall, Leafflake, and Nitche soils are representative of soils that formed in sandy eolian or outwash material deposited over till.

The dominant parent materials of the Alexandria Moraine consist of both Wadena Lobe and Des Moines Lobe Till (Schneider). Chapett, Friberg, Heimdal, Sisseton, and Snellman soils formed in Wadena Lobe Till. Forman, Gonvick, Naytahwaush, Parnell, Peever, and Waukon soils are examples of soils that formed in Des Moines Lobe Till in the Alexandria and Altamont Moraines. Also, there are local areas of outwash, glaciolacustrine deposits, and organic soils and areas that have clayey or silty lacustrine sediments over both types of till. Also in the Alexandria Moraine are ice-walled lake plains. The soils in these areas formed in thick, clayey lacustrine sediments.

The dominant parent material of the Big Stone Moraine is fine loamy till. Barnes, Langhei, Lakepark, Formdale, Aazdahl, and Parnell soils are the major soils that formed in this till. Cathro soils formed in organic material over till. Seelyeville and Rifle soils formed in deep or very deep organic material on till plains and moraines.

Several outwash sediments derived from different sources and at different times are scattered throughout the county on pitted outwash plains and kame moraines. The parent material ranges from sands to loamy mantled sands and gravels. Hubbard, Duelm, Dorset, Corliss, Pinelake, Oylen, Arvilla, Sandberg, Lida, Two Inlets, and Eagleview soils are the major soils that formed in outwash. Nidaros soils formed in organic material over loamy sediments underlain by sandy or gravelly sediments. Rifle and Seelyeville soils are the major soils that formed in deep or very deep organic materials on outwash plains.

The parent materials of the Red River Valley, formerly Glacial Lake Agassiz, are fine-loamy till and glaciolacustrine deposits. Hamerly, Doran, and Grimstad soils are the major soils in the part of the Red River Valley that is in Otter Tail County.

Time

Time is required for the transformation of the parent material into a natural body that exhibits genetically altered soil layers or soil development. Generally, the maturity of a soil is indicated by the degree of soil development.

Immediately after the glacier receded and outwash materials were deposited about 10,000 to 12,000 years ago, the soil could not support the vegetation or crops that are now grown. Plants that could grow on fresh parent material and tolerate the cold climate contributed to soil development. With time, climatic changes, and the succession of plants, soils reached a state of relative equilibrium. This state of equilibrium between the soil, vegetation, and climate was changed when the clearing and plowing of land began about 135 years ago.

The catena of Rockwood, Blowers, and Paddock soils in the Wadena Drumlin Field represents the most mature or oldest soils in Otter Tail County. This fact is based on the age and source of the parent material as determined by laboratory analysis and on the extent of soil development. Soils that formed in recent lake beach deposits and in the alluvium along rivers and streams are young and exhibit no soil development or only weak development. In respect to geological time, all of the soils in the county are young.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1999). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The table "Classification of the Soils" in Parts I and II of this publication shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Endoaquolls (*Endo*, meaning within, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Endoaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and

characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Endoaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Classification of the Soils

(An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aazdahl-----	Aquic Haploborolls, fine-loamy, mixed
Abbeylake-----	Typic Udipsamments, mixed, frigid
Almora-----	Boralfic Udic Argiborolls, fine-loamy over sandy or sandy-skeletal, mixed
Aquolls-----	Aquolls
Arveson-----	Typic Calciaquolls, coarse-loamy, frigid
Arvilla-----	Udic Haploborolls, sandy, mixed
Barnes-----	Udic Haploborolls, fine-loamy, mixed
Becida-----	Mollic Glossaqualfs, coarse-loamy, mixed, frigid
Bemidji-----	Aquic Arenic Eutroboralfs, loamy, mixed
Blowers-----	Glossaquic Eutroboralfs, coarse-loamy, mixed
Bluffcreek-----	Oxyaquic Eutroboralfs, coarse-loamy, mixed
Bluffton-----	Typic Endoaquolls, fine-loamy, mixed, frigid
Borup-----	Typic Calciaquolls, coarse-silty, frigid
Brandsvold-----	Typic Argiaquolls, fine-loamy, mixed, frigid
Buse-----	Udic Calciborolls, fine-loamy, mixed
Bygland-----	Aquertic Argiborolls, fine, montmorillonitic
Cathro-----	Terric Borosaprists, loamy, mixed, euic
Chapett-----	Boralfic Udic Argiborolls, fine-loamy, mixed
Clearriver-----	Aquic Udipsamments, mixed, frigid
Clitherall-----	Aquic Argiborolls, coarse-loamy, mixed
Clontarf-----	Pachic Udic Haploborolls, coarse-loamy, mixed
Clotho-----	Typic Endoaquolls, coarse-loamy, mixed (calcareous), frigid
Corliss-----	Typic Udipsamments, mixed, frigid
Darnen-----	Pachic Udic Haploborolls, fine-loamy, mixed
Dent-----	Aquic Argiborolls, fine-silty, mixed
Dickey-----	Udorthentic Haploborolls, sandy over loamy, mixed
Doran-----	Aquertic Argiborolls, fine, montmorillonitic
Dorset-----	Udic Argiborolls, coarse-loamy, mixed
Duerm-----	Aquic Haploborolls, sandy, mixed
Eagleview-----	Argic Udipsamments, mixed, frigid
Egeland-----	Udic Haploborolls, coarse-loamy, mixed
Egglake-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Epoufette-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Flaming-----	Aquic Haploborolls, sandy, mixed
Foldahl-----	Aquic Haploborolls, sandy over loamy, mixed
Forada-----	Typic Endoaquolls, coarse-loamy, mixed, frigid
Fordville-----	Pachic Udic Haploborolls, fine-loamy over sandy or sandy-skeletal, mixed
Forman-----	Udic Argiborolls, fine-loamy, mixed
Formdale-----	Udic Haploborolls, fine-loamy, mixed
Foxhome-----	Aquic Haploborolls, sandy-skeletal over loamy, mixed
Friberg-----	Typic Argiaquolls, fine-loamy, mixed, frigid
Glyndon-----	Aeric Calciaquolls, coarse-silty, frigid
Gonvick-----	Aquic Argiborolls, fine-loamy, mixed
Grimstad-----	Aeric Calciaquolls, sandy over loamy, frigid
Hamerly-----	Aeric Calciaquolls, fine-loamy, frigid
*Hangaard-----	Typic Endoaquolls, sandy, mixed, frigid
Hantho-----	Pachic Udic Haploborolls, coarse-silty, mixed
Haslie-----	Limnic Borosaprists, coprogenous, euic
Haug-----	Histic Humaquepts, coarse-loamy, mixed (calcareous), frigid
Heimdahl-----	Udic Haploborolls, coarse-loamy, mixed
Hillview-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Hubbard-----	Udorthentic Haploborolls, sandy, mixed
Isan-----	Typic Endoaquolls, sandy, mixed, frigid
Kandota-----	Mollic Eutroboralfs, fine-loamy, mixed
Kittson-----	Aquic Haploborolls, fine-loamy, mixed
Knute-----	Aquic Argiborolls, fine-loamy, mixed
Kratka-----	Typic Epiaquolls, sandy over loamy, mixed, frigid
Lakepark-----	Cumulic Endoaquolls, fine-loamy, mixed, frigid
Lamoure-----	Cumulic Endoaquolls, fine-silty, mixed (calcareous), frigid
Langhei-----	Typic Eutrochrepts, fine-loamy, mixed, frigid

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Leaflake-----	Arenic Eutroboralfs, loamy, mixed
Leafriver-----	Histic Humaquepts, sandy, mixed, frigid
Lida-----	Mollic Eutroboralfs, coarse-loamy, mixed
Lindaas-----	Typic Argiaquolls, fine, montmorillonitic, frigid
Lizzie-----	Boralfic Udic Argiborolls, fine-silty, mixed
Mahkonce-----	Aquic Eutroboralfs, fine, montmorillonitic
McIntosh-----	Aeric Calciaquolls, fine-silty, frigid
Meehan-----	Aquic Udipsamments, mixed, frigid
Mehurin-----	Aquertic Argiborolls, fine, montmorillonitic
Mustinka-----	Typic Argiaquolls, fine, montmorillonitic, frigid
Naytahwaush-----	Mollic Eutroboralfs, fine, montmorillonitic
Nidaros-----	Terric Borosaprists, loamy, mixed, euic
Nitche-----	Mollic Eutroboralfs, coarse-loamy, mixed
Oakcreek-----	Aquic Argiborolls, fine-loamy, mixed
Oylen-----	Aquic Argiborolls, coarse-loamy, mixed
Paddock-----	Udollic Epiaqualls, coarse-loamy, mixed, frigid
Parnell-----	Vertic Argiaquolls, fine, montmorillonitic, frigid
Peever-----	Udic Argiborolls, fine, montmorillonitic
Pinelake-----	Typic Argiaquolls, coarse-loamy, mixed, frigid
Quam-----	Cumulic Endoaquolls, fine-silty, mixed, frigid
Radium-----	Aquic Haploborolls, sandy, mixed
Rifle-----	Typic Borohemists, euic
Rockwell-----	Typic Calciaquolls, coarse-loamy, frigid
Rockwood-----	Mollic Eutroboralfs, coarse-loamy, mixed
Roliss-----	Typic Endoaquolls, fine-loamy, mixed (calcareous), frigid
Roscommon-----	Mollic Psammaquents, mixed, frigid
Rosy-----	Glossaquic Eutroboralfs, coarse-loamy, mixed
Rothsay-----	Udic Haploborolls, coarse-silty, mixed
Runeberg-----	Typic Endoaquolls, coarse-loamy, mixed, frigid
Rushlake-----	Aquic Udipsamments, mixed, frigid
Sandberg-----	Udorthentic Haploborolls, sandy, mixed
Sedgeville-----	Fluvaquentic Endoaquolls, coarse-loamy, mixed, frigid
Seelyeville-----	Typic Borosaprists, euic
Sioux-----	Udorthentic Haploborolls, sandy-skeletal, mixed
Sisseton-----	Typic Eutrochrepts, coarse-loamy, mixed, frigid
Snellman-----	Typic Eutroboralfs, fine-loamy, mixed
Sugarbush-----	Typic Eutroboralfs, coarse-loamy, mixed
Sverdrup-----	Udic Haploborolls, sandy, mixed
Swenoda-----	Pachic Udic Haploborolls, coarse-loamy, mixed
Sybil-----	Mollic Eutroboralfs, coarse-loamy, mixed
Two Inlets-----	Psammentic Eutroboralfs, sandy, mixed
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Urness-----	Mollic Fluvaquents, fine-silty, mixed (calcareous), frigid
Vallers-----	Typic Calciaquolls, fine-loamy, frigid
Verndale-----	Udic Argiborolls, coarse-loamy, mixed
Waukon-----	Mollic Eutroboralfs, fine-loamy, mixed
Weetown-----	Pachic Udic Argiborolls, fine-loamy, mixed
Winger-----	Typic Calciaquolls, fine-silty, frigid
Wolverton-----	Aquic Calciborolls, coarse-loamy, mixed
Wykeham-----	Aquic Eutroboralfs, fine-loamy, mixed
Wyndmere-----	Aeric Calciaquolls, coarse-loamy, frigid
Zell-----	Udic Calciborolls, coarse-silty, mixed

Acreege and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
7A	Hubbard loamy sand, 0 to 2 percent slopes-----	7,740	0.5
7B	Hubbard loamy sand, 2 to 6 percent slopes-----	14,297	1.0
7C	Hubbard loamy sand, 6 to 12 percent slopes-----	4,362	0.3
26	Aazdahl clay loam-----	9,254	0.6
34	Parnell silty clay loam, depressional-----	6,362	0.4
38B	Waukon loam, 2 to 6 percent slopes-----	8,073	0.6
38C2	Waukon loam, 6 to 12 percent slopes, eroded-----	9,893	0.7
38D2	Waukon loam, 12 to 20 percent slopes, eroded-----	3,229	0.2
38E	Waukon loam, 20 to 30 percent slopes-----	2,506	0.2
46	Borup loam-----	271	*
53B	Kandota sandy loam, 2 to 6 percent slopes-----	29,873	2.1
53C	Kandota sandy loam, 6 to 12 percent slopes-----	10,893	0.8
53D	Kandota sandy loam, 12 to 20 percent slopes-----	1,909	0.1
58	Kittson loam-----	1,338	*
59	Grimstad fine sandy loam-----	548	*
61	Arveson loam-----	1,350	*
63	Rockwell loam-----	4,579	0.3
65	Foxhome sandy loam-----	484	*
66	Flaming loamy fine sand-----	102	*
68	Arveson loam, depressional-----	3,157	0.2
107	Winger silt loam-----	522	*
108	McIntosh silt loam-----	110	*
121	Wykeham fine sandy loam-----	6,652	0.5
127A	Sverdrup sandy loam, 0 to 2 percent slopes-----	1,147	*
127B	Sverdrup sandy loam, 2 to 6 percent slopes-----	3,663	0.2
127C	Sverdrup sandy loam, 6 to 12 percent slopes-----	1,064	*
141B	Egeland fine sandy loam, 1 to 6 percent slopes-----	2,771	0.2
141C	Egeland fine sandy loam, 6 to 12 percent slopes-----	1,450	0.1
141D	Egeland fine sandy loam, 12 to 20 percent slopes-----	428	*
168B	Forman clay loam, 2 to 6 percent slopes-----	7,929	0.6
180	Gonvick loam-----	4,483	0.3
184	Hamerly loam-----	2,066	0.1
187	Haug muck-----	407	*
191	Epoufette sandy loam-----	8,315	0.6
202	Meehan loamy sand-----	1,009	*
258A	Sandberg loamy sand, 0 to 2 percent slopes-----	10,194	0.7
258B	Sandberg loamy sand, 1 to 6 percent slopes-----	2,121	0.1
258C	Sandberg loamy sand, 6 to 12 percent slopes-----	1,735	0.1
260	Duelm loamy sand-----	2,217	0.2
267B	Snellman sandy loam, 2 to 8 percent slopes-----	13,321	0.9
267C	Snellman sandy loam, 8 to 15 percent slopes-----	15,906	1.1
267E	Snellman sandy loam, 15 to 30 percent slopes-----	10,315	0.7
267F	Snellman sandy loam, 30 to 45 percent slopes-----	3,470	0.2
290	Rothsay silt loam-----	1,179	*
293B	Swenoda fine sandy loam, 1 to 4 percent slopes-----	1,276	*
335	Urness mucky silt loam-----	5,181	0.4
339	Fordville loam-----	8,073	0.6
341A	Arvilla sandy loam, 0 to 2 percent slopes-----	2,217	0.2
341B	Arvilla sandy loam, 2 to 6 percent slopes-----	13,905	1.0
371	Clontarf sandy loam-----	2,552	0.2
375	Forada loam-----	1,796	0.1
402C	Sioux loamy sand, 2 to 12 percent slopes-----	700	*
402E	Sioux loamy sand, 12 to 40 percent slopes-----	782	*
406A	Dorset sandy loam, 0 to 2 percent slopes-----	6,898	0.5
406B	Dorset sandy loam, 2 to 6 percent slopes-----	12,887	0.9
418	Lamoure silty clay loam, occasionally flooded-----	343	*
422B	Bygland silty clay loam, 1 to 6 percent slopes-----	5,832	0.4
422C	Bygland silty clay loam, 6 to 15 percent slopes-----	622	*
426	Foldahl loamy fine sand-----	525	*
441A	Almora loam, 0 to 2 percent slopes-----	1,704	0.1
441B	Almora loam, 2 to 6 percent slopes-----	5,181	0.4
441C	Almora loam, 6 to 12 percent slopes-----	1,332	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
481	Kratka fine sandy loam-----	635	*
494	Darnen loam, moderately wet-----	7,616	0.5
497	Hantho silt loam-----	1,535	0.1
508	Wyndmere fine sandy loam-----	192	*
540	Seelyeville muck-----	33,476	2.4
541	Rifle mucky peat-----	1,345	*
544	Cathro muck-----	15,960	1.1
567A	Verndale sandy loam, 0 to 2 percent slopes-----	5,374	0.4
567B	Verndale sandy loam, 2 to 6 percent slopes-----	562	*
609B	Dickey loamy fine sand, 1 to 5 percent slopes-----	489	*
624	Rosy sandy loam-----	17	*
646C	Peever clay loam, 6 to 12 percent slopes-----	4,001	0.3
646D	Peever clay loam, 12 to 18 percent slopes-----	1,505	0.1
670	Knute fine sandy loam-----	864	*
680	Parnell silt loam-----	8,411	0.6
698	Doran clay loam-----	1,031	*
701	Runeberg mucky loam, depressional-----	6,254	0.4
705B	Nitche-Kandota-Lida complex, 1 to 6 percent slopes-----	11,857	0.8
705C	Nitche-Kandota-Lida complex, 6 to 12 percent slopes-----	3,121	0.2
707B	Lizzie silt loam, 2 to 6 percent slopes-----	5,543	0.4
707C2	Lizzie silt loam, 6 to 12 percent slopes, eroded-----	1,637	0.1
707D2	Lizzie silt loam, 12 to 20 percent slopes, eroded-----	387	*
710	Friberg-Weetown complex-----	10,598	0.7
711B	Arvilla-Sandberg complex, 2 to 6 percent slopes-----	948	*
711C	Arvilla-Sandberg complex, 6 to 12 percent slopes-----	15,906	1.1
715	Bluffcreek-Clearriver complex-----	16,484	1.2
716B	Leaflake-Eagleview complex, 1 to 6 percent slopes-----	5,326	0.4
716C	Leaflake-Eagleview complex, 6 to 12 percent slopes-----	777	*
716D	Leaflake-Eagleview complex, 12 to 20 percent slopes-----	300	*
718E	Naytahwaush loam, 15 to 30 percent slopes-----	4,218	0.3
721B	Corliss loamy sand, 2 to 6 percent slopes-----	4,290	0.3
721C	Corliss loamy sand, 6 to 12 percent slopes-----	1,808	0.1
721D	Corliss loamy sand, 12 to 20 percent slopes-----	4,410	0.3
721E	Corliss loamy sand, 20 to 35 percent slopes-----	1,826	0.1
726	Kratka sandy loam, thick solum, depressional-----	1,824	0.1
746	Haslie muck-----	7,712	0.5
760C2	Chapett-Sisseton complex, 6 to 12 percent slopes, eroded-----	36,561	2.6
760D2	Chapett-Sisseton complex, 12 to 20 percent slopes, eroded-----	13,568	1.0
769B	Mehurin clay loam, 1 to 4 percent slopes-----	1,940	0.1
776B	Snellman-Sugarbush complex, 2 to 8 percent slopes-----	14	*
776C	Snellman-Sugarbush complex, 8 to 15 percent slopes-----	218	*
776E	Snellman-Sugarbush complex, 15 to 30 percent slopes-----	95	*
777C2	Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded-----	12,508	0.9
777D2	Sisseton-Heimdal complex, 12 to 20 percent slopes, eroded-----	4,531	0.3
777E	Sisseton-Heimdal complex, 20 to 30 percent slopes-----	1,257	*
778B	Dorset-Corliss complex, 1 to 6 percent slopes-----	34,537	2.4
778C	Dorset-Corliss complex, 6 to 12 percent slopes-----	18,654	1.3
779B	Peever-Mehurin complex, 2 to 6 percent slopes-----	2,335	0.2
902B	Barnes-Buse complex, 2 to 6 percent slopes-----	17,599	1.2
903C2	Barnes-Langhei complex, 6 to 12 percent slopes, eroded-----	16,843	1.2
915C2	Forman-Buse complex, 6 to 12 percent slopes, eroded-----	15,159	1.1
915D2	Forman-Buse complex, 12 to 20 percent slopes, eroded-----	5,832	0.4
931C2	Formdale-Langhei complex, 6 to 12 percent slopes, eroded-----	6,218	0.4
931D2	Formdale-Langhei complex, 12 to 20 percent slopes, eroded-----	806	*
942D2	Langhei-Barnes complex, 12 to 20 percent slopes, eroded-----	4,627	0.3
957B2	Rothsay-Zell complex, 2 to 6 percent slopes, eroded-----	6,025	0.4
969C2	Zell-Rothsay complex, 6 to 12 percent slopes, eroded-----	7,447	0.5
969D2	Zell-Rothsay complex, 12 to 20 percent slopes, eroded-----	636	*
1015	Udipsamments (cut and fill land)-----	952	*
1016	Udorthents, loamy (cut and fill land)-----	2,699	0.2
1027	Udorthents, wet substratum (fill land)-----	461	*
1030	Pits, gravel-Udipsamments complex-----	1,770	0.1

See footnote at end of table.

Acreeage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
1077	Forada and Leafriver soils, depressional-----	12,265	0.9
1102B	Chapett-Dorset complex, 1 to 6 percent slopes-----	1,621	0.1
1102C	Chapett-Dorset complex, 6 to 12 percent slopes, eroded-----	2,988	0.2
1103	Clitherall sandy loam-----	1,975	0.1
1104B	Waukon-Dorset complex, 1 to 6 percent slopes-----	755	*
1104C	Waukon-Dorset complex, 6 to 12 percent slopes, eroded-----	3,663	0.2
1104D	Waukon-Dorset complex, 12 to 20 percent slopes, eroded-----	2,193	0.2
1105B	Dent silt loam, 1 to 6 percent slopes-----	3,880	0.3
1110	Isan sandy loam-----	1,603	0.1
1111	Nidaros muck, frequently flooded-----	8,941	0.6
1112D	Chapett-Corliss complex, 12 to 20 percent slopes, eroded-----	3,133	0.2
1112E	Chapett-Corliss complex, 20 to 30 percent slopes-----	1,185	*
1113	Haslie, Seelyeville, and Cathro soils, ponded-----	17,671	1.2
1114	Hangaard loamy sand, lake beaches-----	758	*
1120	Rushlake-Hangaard complex-----	3,013	0.2
1129	Lindaas silty clay loam, morainic-----	865	*
1131B	Verndale-Abbeylake complex, 1 to 6 percent slopes-----	8,098	0.6
1136	Nidaros muck-----	19,340	1.4
1149	Hamerly clay loam-----	1,685	0.1
1195A	Sybil-Eagleview complex, 0 to 2 percent slopes-----	984	*
1195B	Sybil-Eagleview complex, 2 to 8 percent slopes-----	9,736	0.7
1195C	Sybil-Eagleview complex, 8 to 15 percent slopes-----	4,531	0.3
1195E	Sybil-Eagleview complex, 15 to 30 percent slopes-----	1,492	0.1
1196B	Lida-Two Inlets complex, 1 to 8 percent slopes-----	19,778	1.4
1196C	Lida-Two Inlets complex, 8 to 15 percent slopes-----	22,365	1.6
1196E	Lida-Two Inlets complex, 15 to 30 percent slopes-----	3,273	0.2
1196F	Lida-Two Inlets complex, 30 to 50 percent slopes-----	604	*
1200	Egglake loam-----	812	*
1208B	Naytahwaush-Mahkonce complex, 1 to 8 percent slopes-----	6,555	0.5
1209C	Naytahwaush clay loam, 8 to 15 percent slopes, eroded-----	8,170	0.6
1212B	Mahkonce clay loam, 1 to 4 percent slopes-----	1,958	0.1
1214	Mustinka silty clay loam-----	580	*
1215	Pinelake sandy loam-----	8,140	0.6
1216B	Egglake-Wykeham complex, 0 to 5 percent slopes-----	4,655	0.3
1217E	Waukon-Lida complex, 20 to 35 percent slopes-----	1,238	*
1218B	Snellman-Lida complex, 1 to 8 percent slopes-----	3,244	0.2
1218C	Snellman-Lida complex, 8 to 15 percent slopes-----	7,941	0.6
1218E	Snellman-Lida complex, 15 to 30 percent slopes-----	5,398	0.4
1218F	Snellman-Lida complex, 30 to 45 percent slopes-----	928	*
1219C	Sandberg-Sverdrup complex, 6 to 12 percent slopes-----	2,772	0.2
1221B	Sverdrup-Sandberg complex, 2 to 6 percent slopes-----	2,664	0.2
1223D	Sandberg-Arvilla complex, 12 to 20 percent slopes-----	4,386	0.3
1227	Quam, Cathro, and Urness soils, ponded-----	15,492	1.1
1230	Haslie and Nidaros soils, ponded-----	26,101	1.8
1232B	Chapett loam, 2 to 6 percent slopes-----	18,027	1.3
1232E	Chapett loam, 20 to 30 percent slopes-----	1,552	0.1
1234B	Formdale-Buse complex, 2 to 6 percent slopes-----	20,738	1.4
1237	Lakepark loam-----	7,037	0.5
1239	Quam silt loam-----	10,218	0.7
1240	Roliss clay loam-----	6,170	0.4
1247D	Corliss-Dorset complex, 12 to 20 percent slopes-----	4,965	0.3
1250C	Abbeylake-Verndale complex, 6 to 12 percent slopes-----	680	*
1259	Hamerly-Mustinka complex-----	2,085	0.1
1275B	Kandota-Egglake, depressional, complex, 0 to 8 percent slopes-----	2,236	0.2
1275C	Kandota-Egglake, depressional, complex, 0 to 15 percent slopes-----	1,674	0.1
1276	Knute-Brandsvold complex, thick solum-----	5,736	0.4
1277D	Corliss-Sverdrup complex, 12 to 20 percent slopes-----	822	*
1289	Knute fine sandy loam, thick solum-----	5,374	0.4
1290	Brandsvold fine sandy loam, thick solum-----	4,242	0.3
1291	Sedgeville loam, frequently flooded-----	1,107	*
1293	Sedgeville fine sandy loam, rarely flooded-----	744	*
1304A	Glyndon very fine sandy loam-----	278	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
1307	Rushlake sand-----	1,854	0.1
1317	Vallers silty clay loam-----	524	*
1319B	Rockwood sandy loam, 2 to 6 percent slopes, stony-----	10,484	0.7
1319C	Rockwood sandy loam, 6 to 12 percent slopes, stony-----	2,069	0.1
1319D	Rockwood sandy loam, 12 to 20 percent slopes, stony-----	503	*
1320B	Blowers sandy loam, 1 to 5 percent slopes, stony-----	35,777	2.5
1321	Paddock-Becida complex, stony-----	23,196	1.6
1322	Wolverton very fine sandy loam-----	813	*
1324B	Heimdal-Sisseton complex, 2 to 6 percent slopes-----	8,025	0.6
1338	Oakcreek loam-----	1,557	0.1
1339	Borup mucky silt loam, depressional-----	345	*
1340	Bluffcreek-Epoufette complex-----	2,024	0.1
1341	Clitherall-Wykeham complex-----	5,061	0.4
1342	Pinelake, loamy substratum-Brandsvold complex-----	4,025	0.3
1343C	Lida-Almora-Lizzie complex, 8 to 15 percent slopes-----	1,332	*
1344B	Lida-Almora-Dent complex, 1 to 8 percent slopes-----	3,374	0.2
1345	Bluffcreek-Rosy complex-----	748	*
1346	Nidaros muck, calcareous-----	7,326	0.5
1347B	Kandota loam, 1 to 6 percent slopes-----	5,097	0.4
1348	Knute loam, thick solum-----	3,555	0.2
1349	Clotho loam, moderately permeable-----	300	*
1350	Brandsvold loam, thick solum-----	868	*
1351	Bluffton loam, moderately permeable-----	4,643	0.3
1356	Water, miscellaneous-----	177	*
1365	Hillview fine sandy loam-----	1,135	*
1396	Sedgeville, Nidaros, and Aquolls soils, channeled-----	1,757	0.1
1397	Bemidji loamy sand, moderately permeable-----	698	*
1825B	Seelyville muck, seep land, 1 to 10 percent slopes-----	749	*
1874	Radium loamy sand-----	578	*
1943	Roscommon loamy sand-----	1,046	*
1975	Oylen sandy loam-----	11,303	0.8
W	Water-----	233,212	16.4
	Total-----	1,423,300	100.0

* Less than 0.1 percent.

Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each series description is followed by descriptions of the associated detailed soil map units.

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1999). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may

or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit. The principal hazards and limitations to be considered in planning for specific uses are described in Part II of this survey.

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

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on

the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Waukon loam, 2 to 6 percent slopes, is a phase of the Waukon series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Arvilla-Sandberg complex, 2 to 6 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits component of the map unit Pits, gravel-Udipsamments complex is an example.

The table "Acreage and Proportionate Extent of the Soils" in Parts I and II of this survey gives the acreage and proportionate extent of each map unit. Other tables (see Contents) give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Aazdahl Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed Aquic Haploborolls

Typical Pedon

Aazdahl clay loam, 375 feet west and 2,300 feet north of the southeast corner of sec. 36, T. 132 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine granular; friable; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; many fine roots; about 2 percent gravel; neutral; clear smooth boundary.

Bw1—13 to 18 inches; brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; friable; few fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Bw2—18 to 23 inches; olive brown (2.5Y 4/4) clay loam; weak fine subangular blocky structure; friable; few fine roots; few medium prominent yellowish brown (10YR 5/6) Fe concentrations and common fine distinct dark grayish brown (2.5Y 4/2) Fe depletions; about 2 percent gravel; neutral; clear wavy boundary.

Bk—23 to 36 inches; light olive brown (2.5Y 5/4) clay loam; weak medium subangular blocky structure; friable; common fine angular light gray (10YR 7/2) soft masses of carbonates; common fine distinct grayish brown (2.5Y 5/2) Fe depletions and medium prominent yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; common medium prominent olive gray (5Y 5/2) Fe depletions and common fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 27 inches

Thickness of the mollic epipedon: 10 to 16 inches

Content of rock fragments: 2 to 8 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 to 4

Texture—clay loam or silty clay loam

Bk horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—clay loam, silty clay loam, or loam

C horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—2 to 6
 Texture—clay loam, loam, or silty clay loam

26—Aazdahl clay loam**Composition**

Aazdahl and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines
Position on the landform: Toeslopes
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 9.9 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Formdale and similar soils
- Very poorly drained soils
- Buse and similar soils
- Soils that have a silty surface layer

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Abbeylake Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 1 to 12 percent
Taxonomic classification: Mixed, frigid Typic Udipsamments

Typical Pedon

Abbeylake loamy sand, in an area of Verndale-Abbeylake complex, 1 to 6 percent slopes, 720 feet east and 2,190 feet north of the southwest corner of sec. 1, T. 135 N., R. 39 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; very friable; common very fine and fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bw—8 to 19 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common very fine and fine roots; about 1 percent gravel; neutral; clear wavy boundary.

C1—19 to 27 inches; brown (10YR 5/3) sand; single grain; loose; common very fine and fine roots; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—27 to 60 inches; pale brown (10YR 6/3) sand; single grain; loose; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Content of rock fragments: 0 to 15 percent throughout

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 to 3
 Texture—loamy sand or loamy coarse sand

Bw horizon:

Hue—10YR or 7.5YR
 Value—3 to 5
 Chroma—3 or 4
 Texture—sand, loamy sand, coarse sand, or loamy coarse sand

C horizon:

Hue—10YR

Value—5 or 6
 Chroma—3 or 4
 Texture—sand or coarse sand

1250C—Abbeylake-Verndale complex, 6 to 12 percent slopes

Composition

Abbeylake and similar soils: About 60 percent
 Verndale and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Abbeylake

Texture of the surface layer: Loamy coarse sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderate

Verndale

Texture of the surface layer: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Pinelake and similar soils
- Forada and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Almora Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate or moderately rapid; next part—moderately slow or moderate; lower part—rapid
Landforms: Kame moraines and pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 15 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed Boralfic Udic Argiborolls

Typical Pedon

Almora loam, 0 to 2 percent slopes, 1,175 feet west and 1,800 feet south of the northeast corner of sec. 16, T. 136 N., R. 40 W.

- Ap—0 to 11 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; many very fine and fine roots; very dark gray (10YR 3/1) organic coatings on faces of peds; about 1 percent gravel; slightly acid; abrupt smooth boundary.
- BE—11 to 15 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; moderate fine and medium subangular blocky structure; friable; very dark grayish brown (10YR 3/2) organic coatings and clay coatings on faces of peds; common very fine and fine roots; many continuous distinct light gray (10YR 7/2) very fine sand coatings on faces of peds; about 1 percent gravel; neutral; clear smooth boundary.
- Bt1—15 to 35 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium and coarse subangular blocky structure; friable; few very fine and fine roots; common discontinuous faint dark brown (10YR 3/3) clay films on faces of peds and in pores; about 5 percent gravel; neutral; clear wavy boundary.
- Bt2—35 to 38 inches; dark brown (10YR 4/3) gravelly sandy clay loam; weak medium and coarse subangular blocky structure; friable; few very fine

and fine roots; many continuous distinct very dark grayish brown (7.5YR 3/2) clay films between sand grains and on faces of peds and in pores; about 20 percent gravel; neutral; clear wavy boundary.

2Bt3—38 to 46 inches; dark brown (10YR 3/3) gravelly loamy coarse sand; weak coarse subangular blocky structure; very friable; few very fine and fine roots; many discontinuous faint very dark grayish brown (10YR 3/2) clay films and clay bridging on sand and gravel; about 25 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2C1—46 to 52 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 35 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

2C2—52 to 80 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand; single grain; loose; about 50 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches

Thickness of the mollic epipedon: 8 to 16 inches

Content of rock fragments: 1 to 10 percent in the A and E horizons; 1 to 25 percent in the Bt horizon; 1 to 55 percent, by volume, in the 2B and 2C horizons

Thickness of the loamy mantle: 24 to 40 inches

Ap or A horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 to 3

Texture—loam, sandy loam, or fine sandy loam

Content of rock fragments—1 to 10 percent

BE horizon:

Hue—10YR

Value—3 to 5

Chroma—2 to 4

Texture—loam, fine sandy loam, or sandy loam

Content of rock fragments—1 to 10 percent

Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loam, clay loam, sandy clay loam, silt loam, fine sandy loam, or sandy loam or the gravelly analogs of these textures

Content of rock fragments—1 to 25 percent

2Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 5

Texture—coarse sand, sand, loamy coarse sand, or loamy sand or the gravelly or very gravelly analogs of these textures

Content of rock fragments—1 to 55 percent

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 4

Texture—sand, coarse sand, or the gravelly analogs of these textures or stratified fine sand, loamy fine sand, fine sandy loam, very fine sandy loam, or loam

Content of rock fragments—1 to 55 percent

441A—Almora loam, 0 to 2 percent slopes

Composition

Almora and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Oakcreek and similar soils
- Pinelake and similar soils
- Lida and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

441B—Almora loam, 2 to 6 percent slopes

Composition

Almora and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.3 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Oakcreek and similar soils
- Pinelake and similar soils
- Lida and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent
- Corliss and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

441C—Almora loam, 6 to 12 percent slopes

Composition

Almora and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 7.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Oakcreek and similar soils
- Pinelake and similar soils
- Lida and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Corliss and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Arveson Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—rapid

Landforms: Lake plains and outwash plains

Parent material: Glaciolacustrine deposits or glacial outwash

Slope range: 0 to 1 percent

Taxonomic classification: Coarse-loamy, frigid Typic Calciaquolls

Typical Pedon

Arveson loam, 100 feet west and 1,800 feet north of the southeast corner of sec. 8, T. 132 N., R. 44 W.

Ap—0 to 10 inches; black (N 2/0) loam, dark gray (N 4/0) dry; moderate medium subangular blocky structure; very friable; common fine and very fine roots; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bkg1—10 to 15 inches; very dark gray (5Y 3/1) fine sandy loam; weak medium subangular blocky structure; very friable; common fine and very fine roots; common distinct light gray (5Y 7/1) carbonate coatings on faces of peds; violently effervescent; moderately alkaline; clear wavy boundary.

Bkg2—15 to 30 inches; dark gray (5Y 4/1) fine sandy loam; weak medium subangular blocky structure; very friable; few very fine roots; common faint gray (5Y 5/1) carbonate coatings on faces of peds; violently effervescent; moderately alkaline; clear wavy boundary.

2Cg—30 to 60 inches; light olive gray (5Y 6/2) fine sand; few fine prominent light olive brown (2.5Y 5/4) Fe concentrations; single grain; loose; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 24 inches

Thickness of the loamy mantle: 20 to 60 inches

Content of rock fragments: 0 to 1 percent throughout

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Bkg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 7

Chroma—0 to 2

Texture—sandy loam, fine sandy loam, sandy clay loam, loam, or clay loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—coarse sand, sand, fine sand, loamy sand, or loamy fine sand

61—Arveson loam**Composition**

Arveson and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on lake plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 7.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rockwell and similar soils
- Soils that are underlain by loamy till
- Soils in which carbonates have been leached
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

68—Arveson loam, depressional

Composition

Arveson and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landforms: Depressions on lake plains and outwash plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits or glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 7.5 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Haug and similar soils
- Soils that are underlain by loamy till
- Soils in which carbonates have been leached
- Soils that have loamy layers in the substratum
- Nidaros and similar soils
- Poorly drained soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Arvilla Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderately rapid; lower part—rapid or very rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 20 percent

Taxonomic classification: Sandy, mixed Udic Haploborolls

Typical Pedon

Arvilla sandy loam, 2 to 6 percent slopes, 150 feet east and 1,800 feet south of the northwest corner of sec. 10, T. 133 N., R. 40 W.

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

Bw1—9 to 14 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 4/3) dry; moderate medium subangular blocky structure; very friable; about 2 percent gravel; common very fine and fine roots; neutral; clear smooth boundary.

Bw2—14 to 19 inches; dark brown (10YR 3/3) sandy loam, dark yellowish brown (10YR 4/4) dry; weak fine and medium subangular blocky structure; very friable; about 5 percent gravel; common very fine and fine roots; neutral; clear smooth boundary.

2Bk—19 to 30 inches; brown (10YR 4/3) sand; single grain; loose; common light gray (10YR 7/2) carbonate coatings on the underside of sand grains and pebbles; about 10 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2C—30 to 60 inches; light olive brown (2.5Y 5/4) gravelly sand; single grain; loose; about 15 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 13 to 25 inches

Thickness of the mollic epipedon: 7 to 20 inches

Thickness of the loamy mantle: 14 to 25 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—2.5Y, 10YR, or 7.5YR

Value—2 to 5

Chroma—1 to 4

Texture—sandy loam, coarse sandy loam, loam, or fine sandy loam

Content of rock fragments—0 to 10 percent

2Bk horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—1 to 4
 Texture—sand, coarse sand, or the gravelly or very gravelly analogs of these textures
 Content of rock fragments—5 to 60 percent

2C horizon:

Hue—10YR or 2.5Y
 Value—3 to 6
 Chroma—2 to 6
 Texture—sand, coarse sand, loamy sand, loamy coarse sand, or the gravelly analogs of these textures
 Content of rock fragments—5 to 35 percent

341A—Arvilla sandy loam, 0 to 2 percent slopes

Composition

Arvilla and similar soils: About 95 percent
 Inclusions: About 5 percent

Setting

Landform: Flats on outwash plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Sandberg and similar soils
- Fordville and similar soils
- Oylen and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

341B—Arvilla sandy loam, 2 to 6 percent slopes

Composition

Arvilla and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Sandberg and similar soils
- Fordville and similar soils
- Oylen and similar soils
- Forada and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

711B—Arvilla-Sandberg complex, 2 to 6 percent slopes

Composition

Arvilla and similar soils: About 65 percent
Sandberg and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Arvilla

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: Moderate

Sandberg

Texture of the surface layer: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Fordville and similar soils
- Forada and similar soils
- Leafriver and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

711C—Arvilla-Sandberg complex, 6 to 12 percent slopes

Composition

Arvilla and similar soils: About 50 percent
Sandberg and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Arvilla

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches
Organic matter content: Moderate

Sandberg

Texture of the surface layer: Coarse sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Fordville and similar soils
- Forada and similar soils
- Leafriver and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Barnes Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 20 percent

Taxonomic classification: Fine-loamy, mixed Udic Haploborolls

Typical Pedon

Barnes loam, in an area of Barnes-Buse complex, 2 to 6 percent slopes, 1,000 feet south and 200 feet east of the northwest corner of sec. 20, T. 136 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common medium roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Bw—9 to 17 inches; brown (10YR 4/3) loam; moderate medium subangular blocky structure; friable; common fine roots; very few faint dark brown (10YR 3/3) discontinuous organic coatings on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bk—17 to 36 inches; brown (10YR 5/3) loam; weak fine subangular blocky structure; friable; few fine roots; common fine angular light gray (10YR 7/2) carbonate nodules; about 4 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few fine angular light gray (10YR 7/2) carbonate nodules; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 8 to 31 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 10 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

Bw horizon:

Hue—10YR or 2.5Y

Value—2 to 5

Chroma—2 to 4

Texture—loam or clay loam

Bk horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 4

Texture—loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam

902B—Barnes-Buse complex, 2 to 6 percent slopes

Composition

Barnes and similar soils: About 60 percent

Buse and similar soils: About 25 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: Barnes—2 to 6 percent; Buse—3 to 6 percent

Component Description

Barnes

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches

Organic matter content: Moderate

Buse

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lakepark and similar soils
- Quam and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Darnen and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

903C2—Barnes-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Barnes and similar soils: About 55 percent
 Langhei and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Barnes

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches
Organic matter content: Moderate

Langhei

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lakepark and similar soils
- Quam and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Darnen and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Becida Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderate; next part—slow; lower part—very slow
Landform: Drumlins
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, frigid Mollic Glossaqualfs

Typical Pedon

Becida loam, in an area of Paddock-Becida complex, stony, 2,600 feet west and 400 feet south of the northeast corner of sec. 21, T. 136 N., R. 36 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam,

dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common fine and very fine roots; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Eg—8 to 13 inches; dark grayish brown (10YR 4/2) fine sandy loam, very pale brown (10YR 7/3) dry; strong thick platy structure; very friable; common fine prominent dark reddish brown (5YR 3/3) and common fine and medium prominent brown (7.5YR 4/4) Fe concentrations; few very fine roots; about 1 percent gravel; moderately acid; clear wavy boundary.

E/B—13 to 27 inches; 70 percent grayish brown (2.5Y 5/2) sandy loam (Eg) and 30 percent brown (10YR 4/3) sandy loam (Bt); weak medium subangular blocky structure; friable; common fine and medium prominent yellowish red (5YR 5/8 and 4/6) Fe concentrations; common patchy faint gray (10YR 5/1) clay films on faces of peds; few fine roots; about 3 percent gravel; moderately acid; clear wavy boundary.

Btg—27 to 34 inches; grayish brown (2.5Y 5/2) sandy loam; moderate medium subangular blocky structure; friable; common fine and medium distinct strong brown (7.5YR 5/6) and common fine yellowish red (5YR 4/6) Fe concentrations; common patchy faint gray (10YR 5/1) and dark brown (10YR 4/3) clay films on faces of peds; about 2 percent gravel; moderately acid; clear wavy boundary.

Bt1—34 to 49 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate coarse subangular blocky structure; friable; many medium and coarse prominent strong brown (7.5YR 4/6) Fe concentrations and common fine distinct light brownish gray (10YR 6/2) Fe depletions; few patchy faint dark grayish brown (10YR 4/2) clay films on faces of peds; few patchy prominent very dark grayish brown (10YR 3/2) iron-manganese stains in pores and on faces of peds; about 7 percent gravel; slightly acid; clear wavy boundary.

Bt2—49 to 58 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; few fine and medium distinct light olive brown (2.5Y 5/3) Fe depletions; few patchy distinct very dark grayish brown (10YR 3/2) and common discontinuous dark yellowish brown (10YR 4/4) clay films in pores and on faces of peds; about 5 percent gravel; slightly acid; clear wavy boundary.

BCd—58 to 80 inches; light olive brown (2.5Y 5/3) sandy loam; massive breaking to moderate platy

soil fragments; firm; common medium prominent yellowish brown (10YR 5/6) Fe concentrations and many medium and coarse distinct light brownish gray (2.5Y 6/2) Fe depletions; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Depth to dense till: 40 to 60 inches

Combined thickness of the Bt horizon: 14 to 40 inches

Content of rock fragments: 2 to 15 percent gravel; 0 to 3 percent cobbles

A or Ap horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Content of rock fragments—2 to 15 percent gravel; 0 to 3 percent cobbles

E or Eg horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, or loamy sand

Content of rock fragments—2 to 15 percent gravel; 0 to 3 percent cobbles

EB, E/B, B/E, or BE horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 (upper part); 2 to 4 (lower part)

Texture—dominantly sandy loam or fine sandy loam; subhorizons of loam or sandy clay loam in some pedons

Content of rock fragments—2 to 15 percent gravel; 0 to 3 percent cobbles

Cd horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—dominantly sandy loam or fine sandy loam; subhorizons of loamy sand in some pedons

Content of rock fragments—2 to 15 percent gravel; 0 to 3 percent cobbles

Bemidji Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—moderate

Landform: Moraines

Parent material: Eolian deposits over till

Slope range: 1 to 3 percent

Taxonomic classification: Loamy, mixed Aquic Arenic
Eutroboralfs

Typical Pedon

Bemidji loamy sand, moderately permeable, 1,700 feet east and 175 feet north of the southwest corner of sec. 33, T. 136 N., R. 38 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak very fine subangular blocky structure; very friable; common fine roots; moderately acid; abrupt smooth boundary.

E—8 to 29 inches; brown (10YR 4/3) sand, pale brown (10YR 6/3) dry; single grain; loose; few fine roots; slightly acid; clear smooth boundary.

Bt1—29 to 33 inches; yellowish brown (10YR 4/4) sand; single grain; loose; few fine roots; common patchy prominent brown (7.5YR 4/3) clay bridging between sand grains; common coarse prominent brown (7.5YR 4/4) and light brownish gray (2.5Y 6/2) and common distinct dark yellowish brown (10YR 4/4) Fe depletions; few fine rounded iron-manganese concretions; slightly acid; clear smooth boundary.

Bt2—33 to 36 inches; brown (7.5YR 4/4) loamy sand; weak medium and thick platy structure; very friable; few fine roots; many continuous distinct dark brown (7.5YR 3/2) clay films on faces of peds; slightly acid; clear smooth boundary.

2Bt3—36 to 45 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium and coarse subangular blocky structure; friable; few very fine roots; common discontinuous distinct brown (7.5YR 4/3) clay films on faces of peds; common medium and coarse prominent light brownish gray (2.5Y 6/2) and distinct dark grayish brown (10YR 4/2) Fe depletions; common irregular medium soft masses of iron-manganese; about 5 percent gravel; slightly acid; clear smooth boundary.

2Bt4—45 to 60 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium and coarse subangular blocky structure; friable; few very fine roots; common discontinuous distinct brown (7.5YR 4/3) clay films on faces of peds and few patchy distinct dark grayish brown (10YR 4/2)

clay films in root channels or pores; many medium and coarse distinct grayish brown (10YR 5/2) Fe depletions; about 5 percent gravel; slightly acid.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches

Content of rock fragments: 0 to 35 percent in the sandy mantle and 5 to 15 percent in the glacial till

Thickness of the sandy mantle: 20 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—fine sand, sand, or loamy sand or the gravelly analogs of these textures

Bt horizon:

Hue—10YR or 7.5YR

Value—2 to 5

Chroma—3 to 6

Texture—sand or loamy sand

2Bt horizon:

Hue—10YR or 2.5Y

Value—2 to 5

Chroma—3 to 5

Texture—sandy clay loam, sandy loam, fine sandy loam, or loam

1397—Bemidji loamy sand, moderately permeable

Composition

Bemidji and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Eolian deposits over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.6 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Bluffton and similar soils
- Kratka and similar soils
- Leaflake and similar soils
- Brandsvold and similar soils
- Soils in which the till is closer to the surface or at a greater depth than in the Bemidji soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Blowers Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow
Landform: Drumlins
Parent material: Till
Slope range: 1 to 5 percent
Taxonomic classification: Coarse-loamy, mixed
 Glossaquic Eutroboralfs

Typical Pedon

Blowers sandy loam, 1 to 5 percent slopes, stony, 50 feet east and 2,625 feet north of the southwest corner of sec. 19, T. 136 N., R. 36 W.

- Ap—0 to 7 inches; very dark gray (10YR 3/1) sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; many very fine and fine roots; slightly acid; abrupt smooth boundary.
- E—7 to 14 inches; brown (10YR 5/3) sandy loam, light gray (10YR 7/2) dry; moderate medium platy

structure parting to weak very fine subangular blocky; very friable; common very fine and fine roots; about 3 percent gravel; slightly acid; clear smooth boundary.

E/B—14 to 19 inches; about 60 percent brown (10YR 5/3) loamy sand (E), about 40 percent brown (10YR 4/3) sandy loam (B); weak medium subangular blocky structure; very friable; few very fine roots; about 3 percent gravel; moderately acid; clear smooth boundary.

B/E—19 to 27 inches; about 75 percent brown (10YR 4/3) sandy loam (B), 25 percent brown (10YR 5/3) loamy sand (E); moderate medium subangular blocky structure; firm; few very fine roots; about 2 percent gravel; moderately acid; clear smooth boundary.

Bt—27 to 36 inches; light olive brown (2.5Y 5/4) sandy loam; moderate coarse subangular blocky structure; firm; few very fine roots; few distinct brown (10YR 4/3) and prominent dark grayish brown (10YR 4/2) clay films on faces of peds; few medium prominent brownish gray (10YR 5/2) and common coarse prominent yellowish red (5YR 4/6) Fe concentrations; few fine prominent light brownish gray (10YR 6/2) Fe depletions; about 2 percent gravel; moderately acid; clear smooth boundary.

BC—36 to 43 inches; light olive brown (2.5Y 5/4) sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; few distinct brown (10YR 4/3) clay films on faces of peds; common fine distinct yellowish brown (2.5Y 5/6) Fe concentrations; about 3 percent gravel; neutral; clear smooth boundary.

Cd—43 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; moderate thick platy soil fragments; firm; about 4 percent gravel; common distinct discontinuous light gray (10YR 7/2) carbonate coatings on faces of peds; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to dense till: 40 to 60 inches
Depth to carbonates: 32 to 60 inches
Content of rock fragments: 2 to 15 percent gravel; 0 to 3 percent cobbles

Ap or A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

Content of rock fragments—2 to 15 percent gravel; 0 to 3 percent cobbles

E horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—2 or 3
 Texture—sandy loam or loamy sand
 Content of rock fragments—2 to 15 percent gravel;
 0 to 3 percent cobbles

EB, E/B, B/E, or BE horizon:

Colors—similar to those of the E and Bt horizons
 Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y
 Value—3 to 6
 Chroma—3 to 6
 Texture—dominantly sandy loam; subhorizons of loam, fine sandy loam, or sandy clay loam in some pedons
 Content of rock fragments—2 to 15 percent gravel;
 0 to 3 percent cobbles

Cd horizon:

Hue—10YR or 2.5Y
 Value—5 or 6
 Chroma—3 to 5
 Texture—dominantly sandy loam; subhorizons of loamy sand in some pedons
 Content of rock fragments—2 to 15 percent gravel;
 0 to 3 percent cobbles

1320B—Blowers sandy loam, 1 to 5 percent slopes, stony

Composition

Blowers and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Drumlins
Position on the landform: Summits and backslopes
Slope range: 1 to 5 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.0 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 6.3 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Becida and similar soils
- Runeberg and similar soils
- Paddock and similar soils
- Rockwood and similar soils
- Clitherall and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Bluffcreek Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic classification: Coarse-loamy, mixed Oxyaquic Eutroboralfs

Typical Pedon

Bluffcreek sandy loam, in an area of Bluffcreek-Clearriver complex, 950 feet west and 50 feet south of the northeast corner of sec. 36, T. 136 N., R. 37 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, dark brown (10YR 4/3) dry; weak fine and medium granular structure; very friable; common very fine and fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.
- E1—8 to 14 inches; dark brown (10YR 4/3) loamy sand, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; very friable; few very fine and fine roots; about 2 percent gravel; slightly acid; clear smooth boundary.
- E2—14 to 26 inches; dark brown (10YR 4/3) sand, light yellowish brown (10YR 6/4) dry; single grain;

loose; about 10 percent gravel; slightly acid; clear wavy boundary.

E&Bt—26 to 34 inches; yellowish brown (10YR 5/4) sand (E); single grain; loose; lamellae of dark yellowish brown (10YR 4/4) sandy loam (Bt); weak very fine subangular blocky structure; very friable; lamellae are discontinuous and are 0.1 to 0.2 inch thick; about 8 percent gravel; moderately acid; clear smooth boundary.

Bt—34 to 42 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; moderate medium and coarse subangular blocky structure; friable; many coarse distinct dark grayish brown (10YR 4/2) Fe depletions and common medium prominent strong brown (7.5YR 5/8) Fe concentrations; many continuous prominent dark brown (7.5YR 3/2) clay films on faces of peds and in pores; 5 percent gravel; moderately acid; clear wavy boundary.

BC—42 to 50 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 3 percent gravel; slightly acid; clear wavy boundary.

C—50 to 80 inches; light brownish gray (10YR 6/2) sand; single grain; loose; common coarse distinct brownish yellow (10YR 6/8) Fe concentrations; about 5 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 30 to 60 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

Content of rock fragments—0 to 15 percent

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—loamy sand, sand, loamy fine sand, loamy coarse sand, or sandy loam

Content of rock fragments—0 to 15 percent

E&Bt, EB, E/B, B/E, or BE horizon:

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—3 or 4

Texture—dominantly sandy loam, coarse sandy

loam, or the gravelly analogs of these textures; subhorizons of sandy clay loam, loam, loamy sand, or loamy coarse sand or the gravelly analogs of these textures in some pedons
Content of rock fragments—0 to 35 percent

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, coarse sand, or sand or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent

C horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 7

Chroma—2 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent

715—Bluffcreek-Clearriver complex

Composition

Bluffcreek and similar soils: About 60 percent

Clearriver and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on pitted outwash plains

Slope range: 0 to 3 percent

Component Description

Bluffcreek

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches

Organic matter content: Moderate

Clearriver

Texture of the surface layer: Loamy coarse sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 4.8 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lida and similar soils
- Epoufette and similar soils
- Nidaros and similar soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1340—Bluffcreek-Epoufette complex

Composition

Bluffcreek and similar soils: About 65 percent
 Epoufette and similar soils: About 25 percent
 Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Bluffcreek—flats and slight rises; Epoufette—flats and swales
Slope range: Bluffcreek—0 to 3 percent; Epoufette—0 to 2 percent

Component Description

Bluffcreek

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.3 inches
Organic matter content: Moderate

Epoufette

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 2.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lida and similar soils
- Nidaros and similar soils
- Forada and similar soils
- Soils that have a loamy substratum

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1345—Bluffcreek-Rosy complex

Composition

Bluffcreek and similar soils: About 60 percent
 Rosy and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on pitted outwash plains
Slope range: 0 to 3 percent

Component Description

Bluffcreek

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None

Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches
Organic matter content: Moderate

Rosy

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciofluvial deposits
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lida and similar soils
- Hillview and similar soils
- Epoufette and similar soils
- Nidaros and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Bluffton Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy, mixed, frigid
 Typic Endoaquolls

Typical Pedon

Bluffton loam, moderately permeable, 500 feet south

and 1,100 feet west of the northeast corner of sec. 25, T. 137 N., R. 38 W.

- A1—0 to 7 inches; black (N 2/0) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.
- A2—7 to 10 inches; very dark grayish brown (2.5Y 3/2) loam, grayish brown (10YR 5/2) dry; weak medium platy structure; friable; common fine roots; few fine prominent brown (7.5YR 4/4) Fe concentrations; about 1 percent gravel; neutral; clear smooth boundary.
- Bg1—10 to 15 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; moderate medium subangular blocky structure; friable; few fine roots; few fine prominent brown (7.5YR 4/4) Fe concentrations; about 4 percent gravel; neutral; clear smooth boundary.
- Bg2—15 to 29 inches; light olive brown (2.5Y 5/3) loam; weak fine subangular blocky structure; friable; few fine roots; common fine prominent strong brown (7.5YR 4/6) Fe concentrations; about 4 percent gravel; neutral; clear smooth boundary.
- Bg3—29 to 53 inches; olive (5Y 5/3) loam; weak fine subangular blocky structure; friable; common medium prominent strong brown (7.5YR 4/6) Fe concentrations; about 5 percent gravel; neutral; clear smooth boundary.
- Cg—53 to 80 inches; olive (5Y 5/3) loam; massive; friable; common medium prominent dark yellowish brown (10YR 4/6) Fe concentrations; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 7 to 24 inches
Content of rock fragments: 1 to 10 percent throughout

A1 horizon:

Hue—10YR to 5Y or neutral
 Value—2 or 3
 Chroma—0 to 2
 Texture—mucky loam or loam

A2 horizon:

Hue—10YR, 2.5Y, or neutral
 Value—2 or 3
 Chroma—0 to 2
 Texture—sandy loam, sandy clay loam, or loam

Bg horizon:

Hue—2.5Y or 5Y
 Value—4 or 5
 Chroma—1 to 3

Texture—fine sandy loam, sandy clay loam, clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 to 3

Texture—fine sandy loam, sandy clay loam, or loam

1351—Bluffton loam, moderately permeable

Composition

Bluffton and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 10.3 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Knute and similar soils
- Kratka and similar soils
- Brandsvold and similar soils
- Cathro and similar soils
- Clotho and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Borup Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderately rapid; lower part—moderately rapid or rapid

Landform: Lake plains and outwash plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 1 percent

Taxonomic classification: Coarse-silty, frigid Typic Calciaquolls

Typical Pedon

Borup loam, 220 feet north and 1,850 feet east of the southwest corner of sec. 29, T. 136 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine roots; strongly effervescent; slightly alkaline; gradual wavy boundary.

Ak—8 to 13 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; very friable; common fine roots; many fine light gray (10YR 7/2) carbonate threads; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg1—13 to 22 inches; grayish brown (2.5Y 5/2) silt loam; weak very fine subangular blocky structure; very friable; common fine roots; few medium distinct light olive brown (2.5Y 5/6) Fe concentrations; many fine light gray (10YR 7/2) masses of carbonates; violently effervescent; slightly alkaline; clear wavy boundary.

Bkg2—22 to 32 inches; grayish brown (2.5Y 5/2) very fine sandy loam; weak thin platy structure parting to weak very fine subangular blocky; very friable; few fine roots; many medium prominent dark yellowish brown (10YR 4/6) and many medium prominent strong brown (7.5YR 5/8) Fe concentrations; common fine rounded light gray (10YR 7/2) soft masses of carbonates; strongly effervescent; slightly alkaline; gradual wavy boundary.

Cg—32 to 60 inches; olive gray (5Y 5/2) very fine sandy loam; few very fine roots; many coarse

prominent strong brown (7.5YR 4/6 and 5/8) Fe concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface
Thickness of the mollic epipedon: 7 to 20 inches
Content of rock fragments: Typically none throughout

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—loam

Ak horizon:

Hue—10YR, 2.5Y, or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—silt loam, very fine sandy loam, loam, or sandy clay loam

Bkg horizon:

Hue—10YR, 2.5Y, or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—silt loam, loamy very fine sand, very fine sandy loam, loam, or sandy clay loam

Cg horizon:

Hue—2.5Y, 5Y, or neutral
 Value—4 to 6
 Chroma—0 to 3
 Texture—very fine sandy loam, very fine sand, loamy very fine sand, loam, or silt loam

46—Borup loam

Composition

Borup and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landforms: Flats and swales on lake plains and outwash plains
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Glyndon and similar soils
- Very poorly drained soils
- Soils that have more clay in the subsoil than the Borup soil
- Hillview and similar soils
- Soils that have a leached subsoil
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1339—Borup mucky silt loam, depressional

Composition

Borup and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landforms: Depressions on lake plains and outwash plains
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glyndon and similar soils
- Poorly drained soils
- Soil that have more clay in the subsoil than the Borup soil
- Hillview and similar soils
- Soils that have a leached subsoil
- Cathro and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Brandsvold Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderate or moderately rapid; next part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, mixed, frigid Typic Argiaquolls

Typical Pedon

Brandsvold fine sandy loam, thick solum, 750 feet south and 800 feet east of the northwest corner of sec. 17, T. 133 N., R. 37 W.

Ap—0 to 12 inches; black (10YR 2/1) fine sandy loam, dark grayish brown (10YR 3/2) dry; moderate fine and medium subangular blocky structure; friable; many very fine and fine and common medium roots; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Eg—12 to 17 inches; dark grayish brown (10YR 4/2) sandy loam; moderate medium subangular blocky structure; friable; common very fine roots; common dark gray (10YR 4/1) clay films on faces of pedis; common fine prominent dark reddish brown (5YR 3/2) and many medium distinct brown

(7.5YR 4/3) Fe concentrations; about 2 percent gravel; slightly acid; gradual wavy boundary.

Btg1—17 to 37 inches; grayish brown (2.5Y 5/2) sandy clay loam; moderate medium subangular blocky structure; friable; common very fine roots; common continuous distinct dark grayish brown (10YR 4/2) clay films on faces of pedis; many fine and medium prominent brown (7.5YR 4/4) and common fine prominent reddish brown (5YR 4/4) Fe concentrations; about 10 percent gravel; slightly acid; clear smooth boundary.

Btg2—37 to 45 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium and coarse subangular blocky structure; friable; few very fine roots; few patchy prominent dark gray (10YR 4/1) clay films in root channels or pores; common medium prominent brown (7.5YR 4/4) and many medium and coarse prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel; neutral; clear smooth boundary.

C—45 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; plate-like soil fragments; friable; common fine faint light olive brown (2.5Y 5/3) Fe depletions and common fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 26 to more than 60 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 2 to 12 percent gravel

Other features: Some pedons have an E horizon, which is 2 to 6 inches thick.

Ap or A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sandy loam

Btg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 6

Chroma—0 to 3

Texture—loam, sandy clay loam, or clay loam

Bk horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—loam, sandy loam, or fine sandy loam

C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—fine sandy loam, sandy loam, or loam

1290—Brandsvold fine sandy loam, thick solum

Composition

Brandsvold and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Knute and similar soils
- Soils that have a clayey subsoil
- Bluffton and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1350—Brandsvold loam, thick solum

Composition

Brandsvold and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Knute and similar soils
- Soils that have a clayey subsoil
- Bluffton and similar soils
- Cathro and similar soils
- Mahkonce and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Buse Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 20 percent

Taxonomic classification: Fine-loamy, mixed Udic
Calciborolls

Typical Pedon

Buse loam, in an area of Barnes-Buse complex, 2 to 6 percent slopes, 2,400 feet east and 155 feet south of the northwest corner of sec. 34, T. 132 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine and medium roots; common fine irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 22 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; common medium irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—22 to 40 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; friable; few fine distinct light brownish gray (2.5Y 6/2) relict Fe depletions and prominent strong brown (7.5YR 5/6) relict Fe concentrations; common coarse irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct grayish brown (2.5Y 5/2) relict Fe depletions and few medium and coarse distinct light olive brown (2.5Y 5/6) relict Fe concentrations; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 7 to 10 inches

Content of rock fragments: 2 to 12 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam or clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 6

Texture—loam or clay loam

Bygland Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately slow; next part—moderately slow or slow; lower part—moderately slow

Landforms: Moraines, lake terraces, and ice-walled lake plains

Parent material: Lacustrine deposits

Slope range: 1 to 15 percent

Taxonomic classification: Fine, montmorillonitic
Aquertic Argiborolls

Typical Pedon

Bygland silty clay loam, 1 to 6 percent slopes, 850 feet north and 2,450 feet east of the southwest corner of sec. 25, T. 133 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—10 to 17 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate medium subangular blocky structure; firm; common fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; neutral; clear wavy boundary.

Bt2—17 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay; strong medium angular blocky structure; firm; few fine roots; few distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; neutral; clear wavy boundary.

Bt3—32 to 41 inches; olive brown (2.5Y 4/3) silty clay loam; strong medium subangular blocky structure; firm; few discontinuous distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few fine prominent yellowish brown (10YR 5/8) Fe concentrations; neutral; clear wavy boundary.

BC—41 to 46 inches; light olive brown (2.5Y 5/4) silty clay loam; weak fine subangular blocky structure; firm; few discontinuous prominent very dark grayish brown (10YR 3/2) clay films in root channels and pores; common medium distinct

grayish brown (2.5Y 5/2) and common medium prominent yellowish brown (10YR 5/6) Fe concentrations; slightly effervescent; slightly alkaline; gradual wavy boundary.

C—46 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam; massive; firm; common medium distinct grayish brown (2.5Y 5/2) and few prominent yellowish brown (10YR 5/6) Fe concentrations; few fine light gray (10YR 7/2) carbonate threads; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 42 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: Typically none throughout

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam

Bt horizon:

Hue—10YR or 2.5Y

Value—2 to 4

Chroma—2 to 4

Texture—silty clay, clay, or silty clay loam

BC horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 5

Texture—silty clay loam or silt loam

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—2 to 4

Texture—dominantly silty clay loam or silt loam; varved with very thin lenses of loamy very fine sand or very fine sand in some pedons

422B—Bygland silty clay loam, 1 to 6 percent slopes

Composition

Bygland and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Moraines, lake terraces, and ice-walled lake plains

Position on the landform: Summits and backslopes

Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Lacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Lizzie and similar soils
- Dent and similar soils
- Lindaas and similar soils
- Soils that are underlain by loamy till
- Cathro and similar soils
- Parnell and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

422C—Bygland silty clay loam, 6 to 15 percent slopes

Composition

Bygland and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landforms: Moraines, lake terraces, and ice-walled lake plains

Position on the landform: Backslopes and shoulders

Slope range: 6 to 15 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lizzie and similar soils
- Dent and similar soils
- Lindaas and similar soils
- Soils that are underlain by loamy till
- Cathro and similar soils
- Parnell and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Cathro Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderately rapid to moderately slow; lower part—moderately slow or moderate
Landforms: Lake plains and moraines
Parent material: Organic material over glaciolacustrine deposits or till
Slope range: 0 to 1 percent
Taxonomic classification: Loamy, mixed Euic Terric Borosaprists

Typical Pedon

Cathro muck, 1,200 feet west and 1,500 feet north of the southeast corner of sec. 13, T. 137 N., R. 36 W.

Oa1—0 to 16 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 50 percent fiber, 10 percent rubbed; weak fine granular structure; very friable; many fine roots;

primarily herbaceous fibers, about 10 percent woody fragments; neutral; clear irregular boundary.

Oa2—16 to 38 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 30 percent fibers, 10 percent rubbed; very friable; common fine roots; primarily herbaceous fibers, about 10 percent woody fragments; neutral; clear smooth boundary.

A1—38 to 44 inches; black (N 2/0) mucky sandy loam; massive; friable; neutral; clear smooth boundary.

A2—44 to 48 inches; black (N 2/0) loam; massive; friable; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg—48 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly sandy loam; massive; friable; many coarse faint olive gray (5Y 3/2) Fe depletions; about 20 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to more than 60 inches

Thickness of the histic epipedon: 16 to 50 inches

Content of woody fragments in the organic material: 0 to 15 percent

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—sandy loam, fine sandy loam, sandy clay loam, or loam or the mucky analogs of these textures

C horizon:

Hue—2.5Y, 5Y, 2.5Y, 5GY, or 5BG

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, loam, or sandy clay loam

Content of rock fragments—0 to 25 percent gravel by volume

544—Cathro muck

Composition

Cathro and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Depressions on lake plains and moraines
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 20.4 inches
Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Egglake and similar soils
- Bluffton and similar soils
- Runeberg and similar soils
- Friberg and similar soils
- Knute and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Chapett Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 1 to 30 percent
Taxonomic classification: Fine-loamy, mixed Boralfic Udic Argiborolls

Typical Pedon

Chapett loam (fig. 13), in an area of Chapett-Sisseton

complex, 6 to 12 percent slopes, eroded, 1,100 feet west and 1,300 feet north of the southeast corner of sec. 13, T. 133 N., R. 42 W.

- Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; friable; common fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.
- Bt—7 to 16 inches; brown (10YR 4/3) sandy clay loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; common fine roots; common faint very dark grayish brown (10YR 3/2) clay films on faces of peds; many distinct light brownish gray (10YR 6/2) sand and silt coatings on faces of peds in the upper part; about 2 percent gravel; slightly acid; gradual wavy boundary.
- Btk—16 to 19 inches; brown (10YR 5/3) sandy loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; few fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; common light gray (10YR 7/2) carbonate coatings on ped interiors; about 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk—19 to 27 inches; light yellowish brown (10YR 6/4) sandy loam; weak medium platy structure; friable; few fine roots; common fine light gray (10YR 7/2) carbonate coatings on faces of peds and in pores; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.
- C—27 to 60 inches; yellowish brown (10YR 5/4) sandy loam; weak medium platy soil fragments; friable; few fine distinct yellowish brown (10YR 5/6) relict Fe concentrations; about 4 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 28 inches
Thickness of the mollic epipedon: 7 to 10 inches
Content of rock fragments: 2 to 10 percent throughout

Ap or A horizon:

Hue—10YR or 2.5Y
 Value—2 or 3
 Chroma—1 or 2
 Texture—loam

Bt horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—3 to 6
 Texture—sandy clay loam, fine sandy loam, sandy loam, or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, or loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—fine sandy loam, sandy loam, or loam

760C2—Chapett-Sisseton complex, 6 to 12 percent slopes, eroded**Composition**

Chapett and similar soils: About 55 percent

Sisseton and similar soils: About 30 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Backslopes and shoulders*Slope range:* 6 to 12 percent**Component Description****Chapett***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 9.0 inches*Organic matter content:* Moderate**Sisseton***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 10.2 inches*Organic matter content:* Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Quam and similar soils
- Friberg and similar soils
- Cathro and similar soils
- Roliss and similar soils
- Areas that have stones on the surface
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

760D2—Chapett-Sisseton complex, 12 to 20 percent slopes, eroded**Composition**

Chapett and similar soils: About 50 percent

Sisseton and similar soils: About 35 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Backslopes and shoulders*Slope range:* 12 to 20 percent**Component Description****Chapett***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 8.8 inches*Organic matter content:* Moderate**Sisseton***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Quam and similar soils
- Friberg and similar soils
- Cathro and similar soils
- Weetown and similar soils
- Areas that have stones on the surface
- Areas that have slopes of more than 20 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1102B—Chapett-Dorset complex, 1 to 6 percent slopes

Composition

Chapett and similar soils: About 50 percent
 Dorset and similar soils: About 35 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 6 percent

Component Description

Chapett

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.4 inches
Organic matter content: Moderate

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.3 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Weetown and similar soils
- Friberg and similar soils
- Quam and similar soils
- Almora and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1102C—Chapett-Dorset complex, 6 to 12 percent slopes, eroded

Composition

Chapett and similar soils: About 50 percent
 Dorset and similar soils: About 35 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Chapett

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches
Organic matter content: Moderate

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Weetown and similar soils
- Friberg and similar soils
- Quam and similar soils
- Almora and similar soils
- Areas that have slopes of more than 12 percent
- Sisseton and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1112D—Chapett-Corliss complex, 12 to 20 percent slopes, eroded

Composition

Chapett and similar soils: About 50 percent

Corliss and similar soils: About 35 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Chapett

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches
Organic matter content: Moderate

Corliss

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Sisseton and similar soils
- Weetown and similar soils
- Dorset and similar soils
- Friberg and similar soils
- Quam and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

- Forest Land section

1112E—Chapett-Corliss complex, 20 to 30 percent slopes

Composition

Chapett and similar soils: About 50 percent
 Corliss and similar soils: About 35 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 20 to 30 percent

Component Description

Chapett

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches
Organic matter content: Moderate

Corliss

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Sisseton and similar soils
- Weetown and similar soils
- Dorset and similar soils
- Friberg and similar soils
- Quam and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1232B—Chapett loam, 2 to 6 percent slopes

Composition

Chapett and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Sisseton and similar soils
- Weetown and similar soils
- Friberg and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1232E—Chapett loam, 20 to 30 percent slopes

Composition

Chapett and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 20 to 30 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Sisseton and similar soils
- Weetown and similar soils
- Friberg and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 30 percent or less than 20 percent

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Clearriver Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid

Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic classification: Mixed, frigid Aquic Udipsamments

Typical Pedon

Clearriver loamy coarse sand, in an area of Bluffcreek-Clearriver complex, 2,200 feet north and 2,300 feet east of the southwest corner of sec. 23, T. 132 N., R. 37 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loamy coarse sand, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; friable; about 3 percent gravel; many very fine and fine roots; slightly acid; abrupt smooth boundary.

E—9 to 13 inches; brown (10YR 5/3) loamy coarse sand, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; friable; about 3 percent gravel; many very fine and fine roots; slightly acid; clear wavy boundary.

E&Bt1—13 to 21 inches; brown (10YR 5/3) loamy sand (E); single grain; loose; lamellae and bands of brown (7.5YR 4/4) sandy loam (Bt); moderate fine and medium subangular blocky structure; friable; bands are 1/8 to 1/2 inch thick with a cumulative thickness of less than 3 inches; many discontinuous prominent dark brown (7.5YR 3/4) clay films on faces of peds; common very fine and fine roots; about 12 percent gravel; slightly acid; clear wavy boundary.

E&Bt2—21 to 48 inches; dark yellowish brown (10YR 4/4) sand (E); single grain; loose; lamellae of brown (7.5YR 4/4) loamy sand (Bt); single grain; loose; lamellae are 1/8 to 3/8 inch thick and are characterized by dark brown (7.5YR 3/4) clay bridging between sand grains; many fine and medium prominent light brownish gray (2.5Y 6/2) Fe depletions and many fine distinct yellowish brown (10YR 5/8) Fe concentrations; about 12 percent gravel; slightly acid; clear wavy boundary.

Cg—48 to 60 inches; brownish gray (2.5Y 5/2) gravelly sand; single grain; loose; many fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; about 20 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 13 to 60 inches
Content of rock fragments: 5 to 35 percent throughout

Ap or A horizon:
Hue—10YR

Value—2 to 4
 Chroma—1 or 2
 Texture—loamy coarse sand

E horizon:

Hue—10YR or 7.5YR
 Value—3 to 6
 Chroma—2 to 6
 Texture—sand, loamy sand, loamy coarse sand, loamy fine sand, or fine sand or the gravelly analogs of these textures

E part of the E&Bt horizon:

Hue—10YR or 7.5YR
 Value—3 to 6
 Chroma—2 to 6
 Texture—loamy sand, loamy fine sand, fine sand, or sand

Bt part of the E&Bt horizon:

Hue—10YR or 7.5YR
 Value—3 to 5
 Chroma—4 to 6
 Texture—coarse sandy loam, sandy clay loam, sandy loam, loamy sand, or loamy coarse sand or the gravelly analogs of these textures

Cg horizon:

Hue—10YR or 2.5Y
 Value—4 to 7
 Chroma—2 to 4
 Texture—coarse sand, sand, or fine sand or the gravelly analogs of these textures

Clitherall Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; next part—rapid; lower part—moderate

Landform: Moraines

Parent material: Glacial outwash over till

Slope range: 0 to 3 percent

Taxonomic classification: Coarse-loamy, mixed Aquic Argiborolls

Typical Pedon

Clitherall coarse sandy loam, in an area of Clitherall-Wykeham complex, 325 feet south and 2,700 feet east of the northwest corner of sec. 6, T. 136 N., R. 37 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) coarse sandy loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common very fine and fine roots;

about 5 percent gravel; moderately acid; abrupt smooth boundary.

Bt1—11 to 16 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; moderate medium subangular blocky structure; friable; common continuous faint brown (10YR 4/3) clay films on faces of peds and few discontinuous distinct dark brown (10YR 3/3) clay films on faces of peds and in pores; common discontinuous very pale brown (10YR 7/3) fine sand and silt coatings on faces on peds; few very fine and fine roots; about 10 percent gravel; slightly acid; clear smooth boundary.

Bt2—16 to 23 inches; dark yellowish brown (10YR 4/4) gravelly loamy coarse sand; weak medium and coarse subangular blocky structure; very friable; many very thick continuous distinct very dark grayish brown (10YR 3/2) and many continuous faint dark brown (10YR 3/3) clay films between and on sand grains and pebbles; few very fine and fine roots; about 17 percent gravel; slightly acid; clear smooth boundary.

Bt3—23 to 30 inches; dark brown (10YR 3/3) gravelly coarse sandy loam; weak medium and coarse subangular blocky structure; friable; many continuous faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 16 percent gravel; neutral; clear smooth boundary.

Bw—30 to 45 inches; dark yellowish brown (10YR 4/4) gravelly sand; single grain; loose; common coarse distinct light brownish gray (10YR 6/2) Fe depletions and common medium distinct yellowish brown (10YR 5/6) Fe concentrations; about 18 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2Btk—45 to 52 inches; olive (5Y 5/3) loam; strong fine and medium subangular blocky structure; firm; common fine and medium distinct dark gray (5Y 4/1) Fe depletions and common fine prominent light olive brown (2.5Y 5/6) Fe concentrations; few patchy prominent very dark grayish brown (2.5Y 3/2) clay films in root channels and pores; common calcium carbonate coatings on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

2Bk—52 to 64 inches; light olive brown (2.5Y 5/4) sandy loam; strong medium and thick platy structure parting to weak fine subangular blocky; friable; patchy prominent yellowish brown (10YR 5/6) Fe stains on faces of peds; few fine prominent dark gray (5Y 4/1) Fe depletions; common calcium carbonate coatings on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C—64 to 80 inches; light olive brown (2.5Y 5/4) sandy loam; massive parting to strong medium and thick plate-like soil aggregates; friable; patchy prominent yellowish brown (10YR 5/8) Fe stains on faces of peds; few fine distinct grayish brown (2.5Y 5/2) Fe depletions; few calcium carbonate coatings on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches

Thickness of the mollic epipedon: 8 to 16 inches

Thickness of the loamy mantle: 15 to 24 inches

Depth to glacial till: 40 to 60 inches

Other features: Some pedons have a Bk horizon.

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—coarse sandy loam

Content of rock fragments—1 to 10 percent gravel

Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

Texture—dominantly sandy loam, fine sandy loam, or coarse sandy loam or the gravelly analogs of these textures; subhorizons of sandy clay loam, loamy sand, loamy coarse sand, loam, coarse sand, or sand in some pedons

Content of rock fragments—5 to 35 percent gravel

Bw horizon:

Hue—7.5YR, 10YR, or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures

Content of rock fragments—10 to 35 percent gravel

2Bk or 2Btk horizon

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—1 to 10 percent gravel

2C horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, or loam

Content of rock fragments—1 to 10 percent gravel by volume

1103—Clitherall sandy loam

Composition

Clitherall and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.4 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Oylen and similar soils
- Wykeham and similar soils
- Pinelake and similar soils
- Brandsvold and similar soils
- Kratka and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1341—Clitherall-Wykeham complex**Composition**

Clitherall and similar soils: About 60 percent
 Wykeham and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Clitherall—flats and swales;
 Wykeham—footslopes and toeslopes

Slope range: 1 to 3 percent

Component Description**Clitherall**

Texture of the surface layer: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.3 inches

Organic matter content: High

Wykeham

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Pinelake and similar soils
- Brandsvold and similar soils
- Kratka and similar soils
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Clontarf Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic classification: Coarse-loamy, mixed Pachic Udic Haploborolls

Typical Pedon

Clontarf sandy loam, 500 feet north and 1,200 feet west of the southeast corner of sec. 30, T. 136 N., R. 43 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

A—9 to 13 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; common fine roots; neutral; clear smooth boundary.

Bw1—13 to 18 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common fine roots; neutral; clear smooth boundary.

Bw2—18 to 24 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; very friable; common fine roots; neutral; clear smooth boundary.

2C1—24 to 36 inches; light olive brown (2.5Y 5/4) loamy sand; massive; very friable; few fine roots; common medium distinct grayish brown (2.5Y 5/2) Fe depletions and common fine distinct light olive brown (2.5Y 5/6) Fe concentrations; neutral; clear smooth boundary.

2C2—36 to 60 inches; light yellowish brown (2.5Y 6/4) sand; single grain; loose; common fine distinct light brownish gray (2.5Y 6/2) Fe depletions and common fine distinct light olive brown (2.5Y 5/6) Fe concentrations; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 16 to 34 inches
Thickness of the loamy mantle: 20 to 36 inches

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1
 Texture—sandy loam

Bw horizon:

Hue—10YR or 2.5Y
 Value—3 or 4
 Chroma—2 or 3
 Texture—sandy loam, fine sandy loam, or loam

2C horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 6
 Texture—sand, fine sand, loamy sand, or loamy fine sand
 Content of rock fragments—0 to 15 percent

371—Clontarf sandy loam

Composition

Clontarf and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains
Position on the landform: Footslopes and toeslopes
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Sverdrup and similar soils
- Sandberg and similar soils
- Forada and similar soils
- Egeland and similar soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Clotho Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderate; next part—moderately slow; lower part—moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed (calcareous), frigid Typic Endoaquolls

Typical Pedon

Clotho loam, moderately permeable, 1,950 feet east and 2,630 feet south of the northwest corner of sec. 34, T. 134 N., R. 37 W.

A—0 to 9 inches; black (2.5Y 2/0) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; about 1 percent gravel; common very fine and fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Ag—9 to 14 inches; very dark grayish brown (10YR 2/1) sandy loam, dark gray (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common fine prominent dark reddish brown (5YR 3/4) Fe concentrations; about 1 percent gravel; common fine roots; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bw—14 to 18 inches; dark grayish brown (2.5Y 5/3) sandy loam; weak coarse subangular blocky structure; very friable; common medium and coarse prominent yellowish brown (10YR 5/6) Fe

concentrations; about 1 percent gravel; few very fine roots; slightly effervescent; slightly alkaline; clear smooth boundary.

C1—18 to 28 inches; light brownish gray (2.5Y 6/2) fine sandy loam; massive; friable; common fine and medium prominent brownish yellow (10YR 6/8) Fe concentrations; about 1 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

C2—28 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; many coarse faint light olive brown (2.5Y 5/3) mottles; massive parting to weak thin and medium platy soil fragments; very friable; common medium prominent reddish yellow (7.5YR 6/8) and many coarse prominent (10YR 6/6) Fe concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 10 to 20 inches

Content of rock fragments: 2 to 20 percent throughout

Ap or A horizon:

Hue—10YR, 2.5Y, or 5Y

Value—1 to 3

Chroma—1 or 2

Texture—sandy loam or loam

Bg or Bw horizon:

Hue—10YR, 2.5Y, or 5Y

Value—3 to 6

Chroma—1 to 6

Texture—sandy loam or fine sandy loam

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 to 4

Texture—sandy loam or fine sandy loam

1349—Clotho loam, moderately permeable

Composition

Clotho and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Knute and similar soils
- Brandsvold and similar soils
- Bluffton and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Corliss Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid or very rapid

Landforms: Pitted outwash plains and moraines

Parent material: Glacial outwash

Slope range: 1 to 35 percent

Taxonomic classification: Mixed, frigid Typic Udipsamments

Typical Pedon

Corliss loamy sand, 6 to 12 percent slopes, 1,650 feet north and 1,625 feet west of the southeast corner of sec. 4, T. 136 N., R. 39 W.

Ap—0 to 7 inches; black (10YR 2/1) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; common very fine and fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw—7 to 28 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; few very fine and

fine roots; about 13 percent gravel; neutral; clear smooth boundary.

C—28 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 32 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches

Content of rock fragments: 10 to 35 percent

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1 to 3

Texture—loamy sand or loamy coarse sand

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, coarse sand, or sand or the gravelly analogs of these textures

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—coarse sand, sand, or the gravelly analogs of these textures

721B—Corliss loamy sand, 2 to 6 percent slopes

Composition

Corliss and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.2 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Radium and similar soils
- Isan and similar soils
- Abbeylake and similar soils
- Clontarf and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

721C—Corliss loamy sand, 6 to 12 percent slopes

Composition

Corliss and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Radium and similar soils
- Isan and similar soils
- Clontarf and similar soils
- Very poorly drained soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

721D—Corliss loamy sand, 12 to 20 percent slopes***Composition***

Corliss and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Radium and similar soils

- Isan and similar soils
- Clontarf and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

721E—Corliss loamy sand, 20 to 35 percent slopes***Composition***

Corliss and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 20 to 35 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lida and similar soils
- Rushlake and similar soils
- Hangaard and similar soils
- Nidaros and similar soils
- Clontarf and similar soils

- Areas that have slopes of more than 35 percent or less than 20 percent

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1247D—Corliss-Dorset complex, 12 to 20 percent slopes

Composition

Corliss and similar soils: About 65 percent
Dorset and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Corliss

Texture of the surface layer: Loamy coarse sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches
Organic matter content: Moderate

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oakcreek and similar soils
- Oylen and similar soils
- Almora and similar soils
- Leafriver and similar soils
- Nidaros and similar soils
- Pinelake and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1277D—Corliss-Sverdrup complex, 12 to 20 percent slopes

Composition

Corliss and similar soils: About 55 percent
Sverdrup and similar soils: About 30 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 12 to 18 percent

Component Description

Corliss

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches
Organic matter content: Moderate

Sverdrup

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Forada and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Darnen Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Moraines

Parent material: Colluvium over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed Pachic Udic Haploborolls

Typical Pedon

Darnen loam, moderately wet, 2,500 feet north and 900 feet east of the southwest corner of sec. 9, T. 136 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; very friable; common fine roots; neutral; abrupt smooth boundary.

A—9 to 26 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very friable; common fine roots; neutral; clear smooth boundary.

AB—26 to 36 inches; very dark brown (10YR 2/2) loam, very dark gray (10YR 3/1) dry; moderate

medium angular blocky structure; friable; common fine roots; few very dark gray (10YR 3/1) sand coatings on faces of peds; neutral; clear smooth boundary.

Bw—36 to 43 inches; light olive brown (2.5Y 5/4) loam; moderate medium subangular blocky structure; friable; few fine roots; common fine prominent brownish yellow (10YR 6/8) Fe concentrations; neutral; clear smooth boundary.

C1—43 to 56 inches; light brownish gray (2.5Y 6/2) loam; friable; common fine prominent brownish yellow (10YR 6/6) and medium brownish yellow (10YR 6/8) Fe concentrations; about 1 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2—56 to 60 inches; light brownish gray (2.5Y 6/2) loam; friable; common coarse prominent yellowish brown (10YR 5/8) and brownish yellow (10YR 6/8) Fe concentrations; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 60 inches

Thickness of the mollic epipedon: 24 to 48 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—loam or clay loam

Content of rock fragments—1 to 5 percent

494—Darnen loam, moderately wet

Composition

Darnen and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Swales on moraines

Position on the landform: Toeslopes

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Barnes and similar soils
- Langhei and similar soils
- Lakepark and similar soils
- Soils that have carbonates above the subsoil
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dent Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landforms: Lake terraces, pitted outwash plains, and kame moraines
Parent material: Glaciolacustrine deposits
Slope range: 1 to 6 percent
Taxonomic classification: Fine-silty, mixed Aquic Argiborolls

Typical Pedon

Dent silt loam, 1 to 6 percent slopes, 1,850 feet south and 250 feet east of the northwest corner of sec. 22, T. 135 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—9 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; friable; common discontinuous very fine sand and silt coatings on faces of peds; neutral; abrupt smooth boundary.

Bt1—12 to 18 inches; brown (10YR 4/3) silty clay loam; strong coarse prismatic structure parting to strong medium angular blocky; firm; many continuous distinct very dark brown (10YR 2/2) clay films on faces of peds and in pores; neutral; clear smooth boundary.

Bt2—18 to 26 inches; brown (10YR 4/3) silt loam; moderate coarse prismatic structure parting to moderate medium angular blocky; firm; common fine distinct grayish brown (2.5Y 5/2) Fe depletions; common continuous distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; neutral; clear smooth boundary.

Btk1—26 to 44 inches; light yellowish brown (10YR 6/4) silt loam; weak coarse subangular blocky structure; friable; common medium prominent strong brown (7.5YR 4/6) Fe concentrations and common fine prominent grayish brown (2.5Y 5/2) Fe depletions; common discontinuous prominent dark brown (7.5YR 3/2) clay films in pores; common light gray (10YR 7/2) carbonate coatings on faces of peds; strongly effervescent; moderately alkaline; clear smooth boundary.

Btk2—44 to 54 inches; light yellowish brown (10YR 6/4) silt loam; weak thick platy structure parting to moderate medium subangular blocky; friable; common medium prominent brownish yellow (10YR 6/8) Fe concentrations and few fine prominent grayish brown (2.5Y 5/2) Fe depletions; common discontinuous prominent dark brown (7.5YR 3/2) clay films in pores; common light gray (10YR 7/2) carbonate coatings on faces of peds; strongly effervescent; moderately alkaline; clear smooth boundary.

C—54 to 80 inches; light olive brown (2.5Y 5/3) silt loam; massive parting to moderate thick platy soil fragments; friable; common coarse prominent strong brown (7.5YR 4/6) Fe concentrations and few fine faint grayish brown (2.5Y 5/2) Fe depletions; few light gray (10YR 7/2) carbonate coatings on vertical fractures; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 2 percent throughout

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—silt loam

Bt horizon:

Hue—10YR, 7.5YR, or 2.5Y
 Value—4 or 5
 Chroma—3 or 4
 Texture—silty clay loam, silt loam, or loam

Btk horizon:

Hue—10YR or 2.5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—silt loam, loam, very fine sandy loam, or thin layers of loamy very fine sand or very fine sand

C horizon:

Hue—2.5Y
 Value—5 or 6
 Chroma—2 to 4
 Texture—silt loam, loam, very fine sandy loam, or thin layers of loamy very fine sand or very fine sand

1105B—Dent silt loam, 1 to 6 percent slopes

Composition

Dent and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landforms: Moraines and lake terraces
Position on the landform: Backslopes and toeslopes
Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this

map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Lizzie and similar soils
- Almora and similar soils
- Lida and similar soils
- Bluffcreek and similar soils
- Lindaas and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Dickey Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—rapid; lower part—moderately slow or moderate
Landform: Moraines
Parent material: Glacial outwash over till
Slope range: 1 to 5 percent
Taxonomic classification: Sandy over loamy, mixed Udorthentic Haploborolls

Typical Pedon

Dickey loamy fine sand, 1 to 5 percent slopes, 250 feet east and 2,000 feet south of the northwest corner of sec. 10, T. 132 N., R. 44 W.

- Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.
- A—9 to 13 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; very friable; few fine and very fine roots; neutral; clear smooth boundary.
- Bw1—13 to 18 inches; brown (10YR 4/3) loamy fine sand; weak fine subangular blocky structure; very friable; few fine and very fine roots; neutral; gradual wavy boundary.

Bw2—18 to 28 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; few very fine roots; neutral; clear wavy boundary.

2Bk—28 to 49 inches; pale brown (10YR 6/3) clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; many faint very pale brown (10YR 7/3) carbonate coatings on faces of peds; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C—49 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 10 to 16 inches

Depth to glacial till: 20 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 to 4

Chroma—1

Texture—loamy fine sand

Bw horizon:

Hue—10YR or 2.5Y

Value—2 to 5

Chroma—1 to 4

Texture—loamy fine sand, fine sand, loamy sand

2Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam, clay loam, silt loam, or silty clay loam

Content of rock fragments—1 to 10 percent

2C horizon:

Hue—10YR to 5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—1 to 10 percent

609B—Dickey loamy fine sand, 1 to 5 percent slopes

Composition

Dickey and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 5 percent

Component Description

Texture of the surface layer: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.9 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Formdale and similar soils
- Swenoda and similar soils
- Areas that have slopes of more than 5 percent
- Soils in which the till is at a greater depth than in the Dickey soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Doran Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderately slow; next part—slow or moderately slow; lower part—moderately slow or moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic classification: Fine, montmorillonitic Aquertic Argiborolls

Typical Pedon

Doran clay loam, 380 feet east and 200 feet south of the northwest corner of sec. 19, T. 131 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very

dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; many fine roots; neutral; clear smooth boundary.

Bt—9 to 19 inches; olive brown (2.5Y 4/3) clay; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; firm; common fine and very fine roots; common continuous faint dark grayish brown (2.5Y 4/2) clay films on faces of pedis; neutral; clear wavy boundary.

2Bky—19 to 32 inches; grayish brown (2.5Y 5/2) clay loam; weak fine and medium subangular blocky structure; friable; few fine and very fine roots; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; common discontinuous prominent light gray (10YR 7/2) carbonate coatings on faces of pedis; many medium irregular soft masses of carbonate; few fine rounded masses of gypsum; about 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2C—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic soil fragments; firm; many medium and coarse yellowish brown (10YR 5/6) Fe concentrations; few medium irregular soft masses of iron-manganese; few fine irregular soft masses of carbonate; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 24 inches

Thickness of the mollic epipedon: 7 to 16 inches

Depth to the underlying glacial till: 15 to 40 inches

Content of rock fragments: 3 to 10 percent in the underlying glacial till

Ap or A horizon:

Hue—10YR

Value—2

Chroma—1

Texture—clay loam

Bt horizon:

Hue—2.5Y or 10YR

Value—2 to 4

Chroma—1 to 3

Texture—clay loam, clay, silty clay, or silty clay loam

2Bky horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—clay loam

2C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—clay loam or loam

698—Doran clay loam

Composition

Doran and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on lake plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 3 to 5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamerly and similar soils
- Mustinka and similar soils
- Peever and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dorset Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landforms: Pitted outwash plains and moraines

Parent material: Glacial outwash

Slope range: 0 to 20 percent

Taxonomic classification: Coarse-loamy, mixed Udic
Argiborolls

Typical Pedon

Dorset sandy loam, 2 to 6 percent slopes, 1,690 feet east and 250 feet north of the southwest corner of sec. 13, T. 134 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; friable; common very fine and fine roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

A—9 to 11 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; friable; few very fine and fine roots; about 5 percent gravel; neutral; clear wavy boundary.

Bt1—11 to 15 inches; brown (10YR 4/3) sandy loam; moderate medium subangular blocky structure; friable; many discontinuous faint dark brown (10YR 3/3) clay films on faces of peds and in pores; about 5 percent gravel; neutral; clear wavy boundary.

Bt2—15 to 20 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; common patchy faint dark yellowish brown (10YR 3/4) clay films on faces of peds; about 10 percent gravel; neutral; clear wavy boundary.

2Bk—20 to 38 inches; olive brown (2.5Y 4/4) gravelly coarse sand; single grain; loose; many light gray (10YR 7/2) carbonate coatings on the underside of pebbles; about 27 percent gravel; strongly effervescent; moderately alkaline; diffuse wavy boundary.

2C—38 to 60 inches; light olive brown (2.5Y 5/3) gravelly coarse sand; single grain; loose; few light gray (10YR 7/2) carbonate coatings on the underside of pebbles; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 36 inches

Thickness of the mollic epipedon: 7 to 15 inches

Thickness of the loamy mantle: 12 to 22 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 10 percent gravel

Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loam or sandy loam

Content of rock fragments—0 to 10 percent gravel

2Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—dominantly gravelly loamy sand or gravelly loamy coarse sand; subhorizons of gravelly sandy loam, gravelly coarse sandy loam, gravelly sand, or gravelly coarse sand in some pedons

Content of rock fragments—15 to 35 percent gravel

2Bk horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—3 to 6

Texture—dominantly gravelly coarse sand, gravelly loamy sand, or gravelly sand; subhorizons of coarse sand, sand, or loamy sand or the very gravelly analogs of these textures in some pedons

Content of rock fragments—dominantly 15 to 35 percent gravel; subhorizons with more than 35 percent gravel in some pedons

2C horizon:

Hue—10YR or 7.5YR

Value—3 to 6

Chroma—3 to 6

Texture—dominantly gravelly coarse sand, gravelly loamy sand, or gravelly sand; subhorizons of coarse sand, sand, or loamy sand or the very gravelly analogs of these textures in some pedons

Content of rock fragments—dominantly 15 to 35 percent gravel; subhorizons with more than 35 percent gravel in some pedons

406A—Dorset sandy loam, 0 to 2 percent slopes

Composition

Dorset and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats on pitted outwash plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Corliss and similar soils
- Almora and similar soils
- Oylen and similar soils
- Pinelake and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

406B—Dorset sandy loam, 2 to 6 percent slopes

Composition

Dorset and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.0 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Corliss and similar soils
- Almora and similar soils
- Oylen and similar soils
- Pinelake and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

778B—Dorset-Corliss complex, 1 to 6 percent slopes

Composition

Dorset and similar soils: About 70 percent
 Corliss and similar soils: About 25 percent
 Inclusions: About 5 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 1 to 6 percent

Component Description

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.1 inches

Organic matter content: High

Corliss

Texture of the surface layer: Loamy coarse sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.1 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Almora and similar soils
- Leafriver and similar soils
- Nidaros and similar soils
- Pinelake and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

778C—Dorset-Corliss complex, 6 to 12 percent slopes

Composition

Dorset and similar soils: About 50 percent

Corliss and similar soils: About 35 percent

Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Dorset

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.0 inches

Organic matter content: High

Corliss

Texture of the surface layer: Loamy coarse sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Nitché and similar soils
- Oylen and similar soils
- Almora and similar soils
- Leafriver and similar soils
- Nidaros and similar soils
- Pinelake and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Duelm Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed Aquic
 Haploborolls

Typical Pedon

Duelm loamy sand, 430 feet north and 1,750 feet west of the southeast corner of sec. 1, T. 133 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; soft; many very fine roots; neutral; abrupt smooth boundary.

AB—9 to 16 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; soft; common very fine roots; neutral; clear wavy boundary.

Bw1—16 to 29 inches; brown (10YR 4/3) sand; single grain; loose; few very fine roots; neutral; clear wavy boundary.

Bw2—29 to 35 inches; brown (10YR 5/3) sand; single grain; loose; few very fine roots; few fine faint grayish brown (10YR 5/2), common medium distinct yellowish brown (10YR 5/6), and few distinct dark yellowish brown (10YR 4/6) Fe concentrations; neutral; clear wavy boundary.

C—35 to 56 inches; dark yellowish brown (10YR 4/4) sand; single grain; loose; common medium distinct grayish brown (10YR 5/2) and common coarse prominent reddish brown (5YR 4/4) Fe concentrations; neutral; clear wavy boundary.

Cg—56 to 60 inches; light brownish gray (10YR 6/2) sand; single grain; loose; common fine prominent strong brown (7.5YR 5/6) Fe concentrations; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 10 to 20 inches
Content of rock fragments: 0 to 15 percent gravel

Ap or A horizon:
 Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—loamy sand

Bw horizon:
 Hue—10YR
 Value—3 to 5
 Chroma—2 to 4
 Texture—coarse sand, sand, loamy sand, or loamy coarse sand

C horizon:
 Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—1 to 4
 Texture—coarse sand or sand

260—Duelm loamy sand

Composition

Duelm and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on pitted outwash plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 5.2 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hubbard and similar soils
- Isan and similar soils
- Oylen and similar soils
- Leafriver and similar soils
- Verndale and similar soils
- Meehan and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Eagleview Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Rapid

Landforms: Kame moraines and pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 30 percent

Taxonomic classification: Mixed, frigid Argic
Udipsamments

Typical Pedon

Eagleview loamy sand (fig. 14), in an area of Sybil-Eagleview complex, 2 to 8 percent slopes, 1,870 feet south and 1,060 feet west of the northeast corner of sec. 2, T. 137 N., R. 39 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; very friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

E1—4 to 10 inches; dark yellowish brown (10YR 4/4) sand, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; very friable; common very fine and fine roots; neutral; clear wavy boundary.

E2—10 to 16 inches; yellowish brown (10YR 5/4) sand, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; very friable; common very fine and fine roots; neutral; gradual wavy boundary.

E3—16 to 36 inches; pale brown (10YR 6/3) sand, very pale brown (10YR 7/3) dry; single grain; loose; few very fine and fine roots; neutral; abrupt wavy boundary.

E&Bt—36 to 60 inches; light yellowish brown (10YR 6/4) sand (E); single grain; loose; bands of brown and dark brown (10YR 5/4 and 4/4) loamy sand (Bt); weak medium subangular blocky structure; friable; few very fine and fine roots; neutral.

Range in Characteristics

Content of rock fragments: 0 to 10 percent

Depth to carbonates: 25 to 60 inches

Ap or A horizon:

Hue—10YR

Value—3

Chroma—2 or 3

Texture—loamy sand

E horizon:

Hue—10YR

Value—4 to 6

Chroma—3

Texture—sand, coarse sand, loamy sand, or loamy coarse sand

Bw horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—4 to 6

Texture—sand or coarse sand

E part of the E&Bt horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

Texture—sand or coarse sand

Bt part of the E&Bt horizon:

Hue—7.5YR or 10YR

Value—3 or 4

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, sandy loam, or coarse sandy loam

C horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

Texture of the fine-earth fraction—sand or coarse sand

Egeland Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid

Landforms: Outwash plains and moraines

Parent material: Glacial outwash

Slope range: 1 to 20 percent

Taxonomic classification: Coarse-loamy, mixed Udic
Haploborolls

Typical Pedon

Egeland fine sandy loam, 1 to 6 percent slopes (fig. 15), 2,100 feet east and 1,300 feet south of the northwest corner of sec. 3, T. 133 N., R. 43 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A—9 to 15 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; friable; many fine and very fine roots; neutral; clear smooth boundary.

Bw1—15 to 19 inches; brown (10YR 4/3) fine sandy

loam; moderate fine and medium subangular blocky structure; friable; common fine and very fine roots; neutral; clear smooth boundary.

Bw2—19 to 31 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak fine and medium subangular blocky structure; friable; few fine and very fine roots; neutral; clear smooth boundary.

Bk—31 to 42 inches; light olive brown (2.5Y 5/3) fine sandy loam; weak medium subangular blocky structure; friable; carbonates disseminated throughout; few very fine roots; violently effervescent; moderately alkaline; clear wavy boundary.

C—42 to 60 inches; light olive brown (2.5Y 5/4) loamy fine sand; weak very fine subangular blocky soil aggregates; single grain; very friable; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 45 inches

Thickness of the mollic epipedon: 8 to 16 inches

Content of rock fragments: 0 to 10 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—fine sandy loam

Bw horizon:

Hue—10YR or 2.5Y

Value—2 to 5

Chroma—1 to 4

Texture—sandy loam or fine sandy loam in the upper part and loamy sand or loamy fine sand in the lower part

Bk horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loamy sand, loamy fine sand, sandy loam, fine sandy loam, or loamy very fine sand

C horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loamy sand, loamy fine sand, sandy loam, loamy very fine sand, very fine sandy loam, or fine sandy loam or stratified with loamy and sandy material

141B—Egeland fine sandy loam, 1 to 6 percent slopes

Composition

Egeland and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Outwash plains and moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Fordville and similar soils
- Sandberg and similar soils
- Rothsay and similar soils
- Poorly drained soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

141C—Egeland fine sandy loam, 6 to 12 percent slopes

Composition

Egeland and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landforms: Outwash plains and moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.7 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Zell and similar soils
- Sandberg and similar soils
- Rothsay and similar soils
- Poorly drained soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

141D—Egeland fine sandy loam, 12 to 20 percent slopes

Composition

Egeland and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landforms: Outwash plains and moraines
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.5 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Zell and similar soils
- Sandberg and similar soils
- Rothsay and similar soils
- Poorly drained soils
- Areas that have slopes of more than 20 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Egglake Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Upper part—moderate or moderately rapid; lower part—moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Egglake fine sandy loam, in an area of Egglake-Wykeham complex, 0 to 5 percent slopes, 640 feet

east and 1,290 feet north of the southwest corner of sec. 3, T. 137 N., R. 38 W.

- A**—0 to 4 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; friable; many fine and very fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.
- Eg**—4 to 8 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium platy structure; friable; common fine and very fine roots; common fine and medium prominent yellowish red (5YR 4/6) Fe concentrations; few patchy distinct very dark grayish brown (10YR 3/2) organic coatings in pores; about 3 percent gravel; neutral; abrupt wavy boundary.
- Btg1**—8 to 16 inches; grayish brown (2.5Y 5/2) sandy clay loam; moderate medium and coarse subangular blocky structure; firm; common fine and very fine roots; common patchy faint dark grayish brown (2.5Y 4/2) clay films on faces of peds and in pores; common fine and medium prominent yellowish red (5YR 4/6) and reddish brown (5YR 4/4) Fe concentrations; few patchy distinct very dark grayish brown (10YR 3/2) organic coatings in pores; about 5 percent gravel; neutral; clear wavy boundary.
- Btg2**—16 to 22 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium and coarse subangular blocky structure; friable; common fine and very fine roots; few patchy faint dark grayish brown (2.5Y 5/2) clay films on faces of peds and in pores; few medium prominent dark reddish brown (5YR 3/3) and common medium prominent reddish brown (5YR 4/4) Fe concentrations; about 5 percent gravel; neutral; clear wavy boundary.
- Bkg**—22 to 32 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium subangular blocky structure; friable; few fine and very fine roots; few fine prominent yellowish red (5YR 4/6) and reddish brown (5YR 4/4) Fe concentrations; common fine light gray (10YR 7/2) soft masses of carbonates; about 8 percent gravel; very slightly effervescent; slightly alkaline; gradual wavy boundary.
- Cg**—32 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium platy structure; friable; many coarse faint light yellowish brown (2.5Y 6/4) and common coarse prominent strong brown (7.5YR 4/6) and dark brown (7.5YR 4/4) Fe concentrations; few fine and medium light gray (10YR 7/2) soft masses of carbonates; about 10 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches

Content of rock fragments: 2 to 10 percent

Other features: Some pedons have a Bg or BCg horizon.

A or Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam or fine sandy loam

Btg horizon:

Hue—5Y or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy clay loam, sandy loam, clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 to 4

Texture—sandy loam or coarse sandy loam

1200—Egglake loam

Composition

Egglake and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.2 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Snellman and similar soils
- Wykeham and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1216B—Egglake-Wykeham complex, 0 to 5 percent slopes

Composition

Egglake and similar soils: About 60 percent
Wykeham and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Egglake—footslopes and toeslopes; Wykeham—flats and swales

Slope range: Egglake—0 to 2 percent; Wykeham—1 to 5 percent

Component Description

Egglake

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 8.0 inches
Organic matter content: Moderate

Wykeham

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.7 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Snellman and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Epoufette Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately rapid or rapid; lower part—very rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Epoufette sandy loam, 60 feet south and 1,720 feet east of the northwest corner of sec. 34, T. 132 N., R. 36 W.

Ap—0 to 7 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; few very fine and fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

Btg1—7 to 14 inches; dark grayish brown (10YR 4/2) sandy loam; moderate medium subangular blocky structure; friable; few very fine and fine roots;

common discontinuous faint dark gray (10YR 4/1) and few discontinuous faint very dark grayish brown (10YR 3/2) clay films on vertical and horizontal faces of peds; common fine and medium prominent strong brown (7.5YR 5/6) Fe concentrations; about 2 percent gravel; neutral; clear wavy boundary.

Btg2—14 to 23 inches; grayish brown (10YR 5/2) loamy sand; moderate medium subangular blocky structure; friable; few very fine and fine roots; few patchy faint dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; common medium distinct yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; neutral; clear wavy boundary.

2Btg3—23 to 33 inches; light brownish gray (10YR 6/2) loamy sand; single grain; loose; very few patchy distinct dark grayish brown (10YR 4/2) clay bridges between sand grains; common medium distinct yellowish brown (10YR 5/6) Fe concentrations; about 4 percent gravel; neutral; gradual wavy boundary.

2Cg—33 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; common coarse distinct light olive brown (2.5Y 5/4) Fe concentrations; about 8 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—sandy loam

Content of rock fragments—0 to 15 percent gravel by volume

Eg horizon:

Hue—10YR to 5Y

Value—4 to 6

Chroma—1 or 2

Texture—loamy sand, sand, or coarse sand or the gravelly analogs of these textures

Content of rock fragments—5 to 25 percent gravel

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, coarse sandy loam, sandy loam, loamy sand, loamy coarse sand, or fine sandy loam or the gravelly analogs of these textures

Content of rock fragments—5 to 25 percent gravel

2Cg horizon:

Hue—7.5YR, 10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—sand, coarse sand, or loamy coarse sand or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent gravel

191—Epoufette sandy loam

Composition

Epoufette and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 2.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.2 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Forada and similar soils
- Roscommon and similar soils
- Lida and similar soils
- Nidaros and similar soils
- Soils that have a loamy substratum

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Flaming Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Lake plains

Parent material: Eolian deposits

Slope range: 0 to 3 percent

Taxonomic classification: Sandy, mixed Aquic
Haploborolls

Typical Pedon

Flaming loamy fine sand, 300 feet east and 1,900 feet north of the southwest corner of sec. 29, T. 132 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A—10 to 16 inches; very dark brown (10YR 2/2) loamy fine sand, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; many fine and very fine roots; neutral; clear wavy boundary.

Bw1—16 to 30 inches; brown (10YR 4/3) loamy fine sand; weak fine subangular blocky structure; very friable; few fine and very fine roots; moderately acid; clear wavy boundary.

Bw2—30 to 38 inches; brown (10YR 4/3) fine sand; single grain; loose; few fine distinct light gray (10YR 7/1) Fe depletions and few fine prominent strong brown (7.5YR 4/6) Fe concentrations; moderately acid; clear wavy boundary.

C1—38 to 50 inches; light grayish brown (2.5Y 6/2) fine sand; single grain; loose; few fine prominent strong brown (7.5YR 4/6) Fe concentrations; moderately acid; abrupt wavy boundary.

C2—50 to 60 inches; light olive brown (2.5Y 5/3) fine sand; single grain; loose; few fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; very slightly effervescent; neutral.

Range in Characteristics

Depth to carbonates: 20 to 60 inches

Thickness of the mollic epipedon: 10 to 16 inches

Content of rock fragments: Typically none throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

Bw horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—loamy fine sand, fine sand, loamy sand, or sand

C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—fine sand or sand

66—Flaming loamy fine sand

Composition

Flaming and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Eolian deposits

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Foldahl and similar soils
- Arveson and similar soils
- Very poorly drained soils
- Soils that have carbonates in the surface soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Foldahl Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—rapid; lower part—moderately slow or moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 3 percent

Taxonomic classification: Sandy over loamy, mixed Aquic Haploborolls

Typical Pedon

Foldahl loamy fine sand, 1,100 feet west and 150 feet south of the northeast corner of sec. 16, T. 131 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; very friable; many fine and very fine roots; neutral; abrupt smooth boundary.

A—9 to 14 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; very friable; many fine and very fine roots; neutral; clear smooth boundary.

Bw1—14 to 16 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; very friable; few fine and very fine roots; neutral; clear wavy boundary.

Bw2—16 to 26 inches; dark yellowish brown (10YR 4/4) fine sand; single grain; loose; about 2 percent gravel; neutral; abrupt smooth boundary.

2Bk—26 to 40 inches; light brownish gray (2.5Y 6/2) clay loam; moderate fine and medium prismatic structure parting to weak thin platy; firm; common fine and medium prominent strong brown (7.5YR 5/8) Fe concentrations; many fine irregular light gray (10YR 7/2) carbonate threads; about 10 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg—40 to 60 inches; light grayish brown (2.5Y 6/2) clay loam; massive; firm; common fine prominent yellowish brown (10YR 5/6) Fe concentrations; few prominent black (N 2/0) iron-manganese stains; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 32 inches

Thickness of the mollic epipedon: 7 to 16 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy fine sand

Content of rock fragments—0 to 8 percent

Bw horizon:

Hue—10YR

Value—3 or 4

Chroma—2 to 4

Texture—loamy fine sand, fine sand, loamy sand, or sand

Content of rock fragments—0 to 8 percent

2Bk horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, loam, silt loam, or clay loam

Content of rock fragments—2 to 15 percent

2Cg horizon:

Hue—10YR or 2.5Y

Value—5 to 7

Chroma—2 to 4

Texture—silt loam, clay loam, loam

Content of rock fragments—2 to 15 percent

426—Foldahl loamy fine sand

Composition

Foldahl and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy fine sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Flaming and similar soils
- Rockwell and similar soils
- Soils that are underlain by outwash
- Soils that have carbonates above the subsoil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Forada Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderate; next part—moderately rapid; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 1 percent

Taxonomic classification: Coarse-loamy, mixed, frigid Typic Endoaquolls

Typical Pedon

Forada loam, 1,750 feet east and 200 feet south of the northwest corner of sec. 29, T. 134 N., R. 44 W.

Ap—0 to 8 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine and medium subangular blocky structure; friable; few fine and medium roots; common fine prominent strong brown (7.5YR 5/6) Fe concentrations; about 1 percent gravel; neutral; abrupt smooth boundary.

A—8 to 18 inches; black (N 2/0) loam, dark gray (N 4/0) dry; weak fine and medium subangular blocky structure; friable; few fine and medium roots; common fine prominent strong brown (7.5YR 5/6) Fe concentrations; about 1 percent gravel; neutral; gradual wavy boundary.

Bg1—18 to 25 inches; dark gray (5Y 4/1) loam; moderate fine and medium subangular blocky structure; friable; common very fine and fine roots; common fine and medium prominent strong brown (7.5YR 4/6) Fe concentrations; about 3 percent gravel; neutral; clear smooth boundary.

Bg2—25 to 32 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak fine subangular blocky structure; very friable; few very fine and fine roots; common fine distinct gray (5Y 5/1) Fe depletions and few medium prominent brown (7.5YR 4/4) Fe concentrations; about 4 percent gravel; neutral; clear smooth boundary.

Bg3—32 to 36 inches; grayish brown (2.5Y 5/2) sandy loam; weak very fine and fine subangular blocky structure; very friable; few very fine and fine roots; common medium distinct light olive brown (2.5Y 5/4) and common medium faint olive brown (2.5Y 4/3) Fe concentrations; about 10 percent gravel; neutral; clear smooth boundary.

2Cg—36 to 60 inches; light olive brown (2.5Y 5/4) gravelly coarse sand; single grain; loose; common fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 15 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches

Thickness of the mollic epipedon: 10 to 24 inches

Thickness of the loamy mantle: 20 to 40 inches

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam

Content of rock fragments—0 to 10 percent

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam; subhorizons of sandy clay loam, loamy sand, or loamy coarse sand

Content of rock fragments—0 to 10 percent

2Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 6

Texture—sand, coarse sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent

375—Forada loam

Composition

Forada and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Leafriver and similar soils
- Nidaros and similar soils
- Arvilla and similar soils
- Egeland and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1077—Forada and Leafriver soils, depressional**Composition**

Forada: Variable

Leafriver: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on pitted outwash plains

Slope range: 0 to 1 percent

Component Description**Forada**

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 6.1 inches

Organic matter content: Very high

Leafriver

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over outwash

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 8.2 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Hubbard and similar soils
- Oylen and similar soils
- Isan and similar soils
- Pinelake and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Fordville Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—rapid or very rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls

Typical Pedon

Fordville loam, 1,250 feet east and 2,050 feet north of the southwest corner of sec. 20, T. 134 N., R. 40 W.

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

A—10 to 22 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; neutral; gradual wavy boundary.

Bw1—22 to 29 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak very fine and fine subangular blocky structure; friable; few fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Bw2—29 to 37 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; about 5 percent gravel; neutral; clear wavy boundary.

2C1—37 to 55 inches; brown (10YR 4/3) gravelly coarse sand; single grain; loose; about 20 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

2C2—55 to 60 inches; olive brown (2.5Y 4/4) gravelly coarse sand; single grain; loose; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 16 to 30 inches

Thickness of the loamy mantle: 20 to 40 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 15 percent

Bw horizon:

Hue—10YR

Value—2 to 4

Chroma—2 to 4

Texture—loam or silt loam

Content of rock fragments—0 to 15 percent

2C horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—2 to 4

Texture—loamy sand, gravelly loamy sand, gravelly sand, gravelly coarse sand, very gravelly sand, or very gravelly loamy sand
Content of rock fragments—5 to 35 percent

339—Fordville loam

Composition

Fordville and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Footslopes and toeslopes

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.8 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Clontarf and similar soils
- Forada and similar soils
- Leafriver and similar soils
- Areas that have slopes of more than 3 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Forman Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 2 to 20 percent

Taxonomic classification: Fine-loamy, mixed Udic Argiborolls

Typical Pedon

Forman clay loam, 2 to 6 percent slopes, 2,300 feet north and 2,500 feet east of the southwest corner of sec. 27, T. 133 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine and very fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 12 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium subangular blocky structure; friable; few fine and very fine roots; common discontinuous faint very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt2—12 to 24 inches; brown (10YR 4/3) clay loam; moderate fine and medium subangular blocky structure; firm; few fine and very fine roots; common discontinuous faint very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 2 percent gravel; neutral; clear smooth boundary.

Bk—24 to 38 inches; light yellowish brown (10YR 6/4) loam; weak medium subangular blocky structure; friable; few very fine roots; many distinct light gray (10YR 7/2) carbonate coatings on faces of peds and many fine and medium irregular light gray (10YR 7/2) soft masses of carbonates in ped interiors; about 3 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

C—38 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; many fine rounded iron-manganese concretions; common fine and medium distinct grayish brown (2.5Y 5/2) relict Fe depletions; about 3 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 27 inches

Thickness of the mollic epipedon: 9 to 16 inches

Content of rock fragments: 2 to 10 percent throughout

Ap or A horizon:

Hue—10YR

Value—2

Chroma—1

Texture—clay loam

Bt horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—1 to 4

Texture—clay loam or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 to 5

Texture—loam or clay loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 5

Texture—loam or clay loam

168B—Forman clay loam, 2 to 6 percent slopes

Composition

Forman and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Parnell and similar soils
- Buse and similar soils
- Roliss and similar soils
- Poorly drained soils
- Areas that have slopes of more than 6 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

915C2—Forman-Buse complex, 6 to 12 percent slopes, eroded

Composition

Forman and similar soils: About 60 percent
Buse and similar soils: About 25 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Forman

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: High

Buse

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Peever and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

915D2—Forman-Buse complex, 12 to 20 percent slopes, eroded

Composition

Forman and similar soils: About 50 percent
Buse and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description

Forman

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: High

Buse

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Peever and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Formdale Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderate; lower part—moderately slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 20 percent
Taxonomic classification: Fine-loamy, mixed Udic Haploborolls

Typical Pedon

Formdale clay loam, in an area of Formdale-Buse complex, 2 to 6 percent slopes, 200 feet west and

2,000 feet north of the southeast corner of sec. 29, T. 131 N., R. 43 W.

- Ap—0 to 7 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; many fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.
- A—7 to 11 inches; very dark brown (10YR 2/2) clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; few fine roots; about 2 percent gravel; neutral; clear smooth boundary.
- Bw1—11 to 14 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; moderate medium prismatic structure grading to weak fine subangular blocky; firm; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.
- Bw2—14 to 18 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; few fine roots; about 2 percent gravel; clear wavy boundary.
- Bk—18 to 30 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few fine roots; common fine irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.
- C—30 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; friable; common medium prominent grayish brown (10YR 5/2) relict Fe depletions; few fine irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 8 to 20 inches
Thickness of the mollic epipedon: 8 to 14 inches
Content of rock fragments: 2 to 8 percent throughout

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—clay loam

Bw horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—3 or 4
 Texture—clay loam, silty clay loam, or loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6
 Chroma—3 or 4
 Texture—clay loam, loam, or silty clay loam

C horizon:

Hue—2.5Y
 Value—5 or 6
 Chroma—3 to 6
 Texture—clay loam, loam, or silty clay loam

931C2—Formdale-Langhei complex, 6 to 12 percent slopes, eroded

Composition

Formdale and similar soils: About 55 percent
 Langhei and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Formdale

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: Moderate

Langhei

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Aazdahl and similar soils

- Hamerly and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

931D2—Formdale-Langhei complex, 12 to 20 percent slopes, eroded

Composition

Formdale and similar soils: About 50 percent
 Langhei and similar soils: About 40 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Formdale

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderate

Langhei

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: Moderately low

A typical soil series description with range in

characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Hamerly and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1234B—Formdale-Buse complex, 2 to 6 percent slopes

Composition

Formdale and similar soils: About 60 percent

Buse and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: Formdale—2 to 6 percent; Buse—3 to 6 percent

Component Description

Formdale

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.2 inches

Organic matter content: Moderate

Buse

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Hamerly and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Foxhome Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; next part—moderately rapid or rapid; lower part—moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 3 percent

Taxonomic classification: Sandy-skeletal over loamy, mixed Aquic Haploborolls

Typical Pedon

Foxhome sandy loam, 2,550 feet north and 240 feet west of the southeast corner of sec. 31, T. 131 N., R. 44 W.

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

A—10 to 13 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine and very fine subangular blocky

structure; friable; common very fine and fine roots; about 8 percent gravel; neutral; clear smooth boundary.

Bw—13 to 16 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 4/3) dry; weak fine and very fine subangular blocky structure; very friable; few fine and very fine roots; about 12 percent gravel; neutral; clear smooth boundary.

2Bk1—16 to 21 inches; light olive brown (2.5Y 5/3) very gravelly coarse sand; single grain; loose; few discontinuous distinct light gray (2.5Y 7/2) carbonate coatings on pebbles; carbonates disseminated throughout; about 50 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.

2Bk2—21 to 27 inches; light yellowish brown (2.5Y 6/3) very gravelly coarse sand; single grain; loose; few discontinuous faint light gray (2.5Y 7/2) carbonate coatings on pebbles; carbonates disseminated throughout; about 35 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

2Bk3—27 to 35 inches; light olive brown (2.5Y 5/4) very gravelly coarse sand; common medium and coarse strong brown (7.5YR 5/6) Fe concentrations; single grain; loose; few discontinuous distinct light gray (2.5Y 7/2) carbonate coatings on pebbles; about 45 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

3Bk4—35 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse prismatic soil fragments; firm; common fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations and common fine medium distinct grayish brown (2.5Y 5/2) Fe depletions; common fine light gray (10YR 7/2) cylindrical carbonate threads; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 11 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Depth to glacial till: 20 to 50 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 15 percent gravel, 0 to 5 percent cobbles

Bw horizon:

Hue—10YR

Value—3 or 4

Chroma—2 or 3

Texture—sandy loam, loamy sand, or loam or the gravelly analogs of these textures

Content of rock fragments—0 to 20 percent

2Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loamy sand, sand, coarse sand, or loamy coarse sand or the very gravelly or extremely gravelly analogs of these textures

Content of rock fragments—35 to 75 percent

3Bk horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—2 or 3

Texture—clay loam or loam

Content of rock fragments—1 to 15 percent

65—Foxhome sandy loam

Composition

Foxhome and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 7.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Foldahl and similar soils
- Grimstad and similar soils

- Hamerly and similar soils
- Kittson and similar soils
- Poorly drained soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Friberg Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderate

Landform: Moraines

Parent material: Colluvium over till

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, mixed, frigid
Typic Argiaquolls

Typical Pedon

Friberg loam, in an area of Friberg-Weetown complex, 1,650 feet west and 300 feet south of the northeast corner of sec. 6, T. 133 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common and many fine and medium roots; about 1 percent gravel; neutral; abrupt smooth boundary.

A—9 to 19 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; common and many fine and medium roots; about 1 percent gravel; neutral; clear wavy boundary.

Btg1—19 to 24 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; firm; few fine roots; common continuous faint black (10YR 2/1) clay films on faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

2Btg2—24 to 41 inches; grayish brown (2.5Y 5/2) sandy clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common medium distinct light olive brown (2.5Y 5/6) Fe concentrations; common continuous prominent very dark gray (10YR 3/1) clay films on faces of

peds, in old root channels, and in pores; about 5 percent gravel; neutral; gradual wavy boundary.

2Btg3—41 to 47 inches; grayish brown (2.5Y 5/2) sandy clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; firm; common medium distinct light olive brown (2.5Y 5/6) Fe concentrations; few patchy prominent very dark gray (10YR 3/1) clay films on faces of peds, in old root channels, and in pores; about 3 percent gravel; neutral; clear wavy boundary.

2Cg—47 to 80 inches; grayish brown (2.5Y 5/2) fine sandy loam; massive; friable; many medium prominent yellowish brown (10YR 5/8) Fe concentrations; few distinct black organic coatings in old root channels and in pores; about 6 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 65 inches

Thickness of the mollic epipedon: 16 to 42 inches

Content of rock fragments: 1 to 8 percent

Ap or A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 5

Chroma—1 or 2

Texture—silty clay loam or clay loam

2Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 5

Chroma—1 or 2

Texture—sandy clay loam or loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 8

Texture—fine sandy loam, loam, sandy loam, or sandy clay loam

710—Friberg-Weetown complex

Composition

Friberg and similar soils: About 50 percent

Weetown and similar soils: About 40 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Friberg—swales; Weetown—
footslopes and toeslopes

Slope range: Friberg—0 to 2 percent; Weetown—1 to
3 percent

Component Description

Friberg

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 10.9 inches

Organic matter content: High

Weetown

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: 3.5 to 6.0 feet

*Available water capacity to 60 inches or root-limiting
layer:* About 9.6 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chapett and similar soils
- Quam and similar soils
- Bluffton and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Brandsvold and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Glyndon Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; next part—
moderate or moderately rapid; lower part—
moderately rapid

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-silty, frigid Aeric
Calciaquolls

Typical Pedon

Glyndon very fine sandy loam, 1,100 feet north and 220 feet east of the southwest corner of sec. 18, T. 132 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; common fine and very fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ak—10 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; carbonates disseminated throughout; violently effervescent; moderately alkaline; clear smooth boundary.

Bk—16 to 24 inches; dark gray (10YR 4/1) loam; weak fine and medium subangular blocky structure; friable; common very fine roots; common fine irregular light gray (10YR 7/2) carbonate threads; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg—24 to 29 inches; grayish brown (2.5Y 5/2) very fine sandy loam; weak fine and medium subangular blocky structure; friable; few very fine roots; few fine distinct light olive brown (2.5Y 5/4) Fe concentrations; carbonates disseminated throughout; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg1—29 to 45 inches; grayish brown (2.5Y 5/2) loamy very fine sand; massive; very friable; many fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; common patchy prominent strong brown (7.5YR 4/6) iron stains on faces of peds and in pores; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2—45 to 60 inches; olive (5Y 5/3) loamy very fine sand; massive; very friable; common fine and medium faint light olive gray (5Y 6/2) Fe depletions and many medium and coarse prominent strong brown (7.5YR 5/6) Fe concentrations; common

patchy distinct dark brown (7.5YR 3/4) iron stains on faces of peds and in pores; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: Typically none throughout

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—very fine sandy loam

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam, loam, silt loam, sandy clay loam, or silty clay loam

Bk horizon:

Hue—10YR to 5Y

Value—4 to 7

Chroma—1 to 4

Texture—silt loam, very fine sandy loam, loam, silty clay loam, or sandy clay loam

C horizon:

Hue—10YR to 5Y

Value—4 to 6

Chroma—2 to 4

Texture—silt loam, very fine sandy loam, loam, loamy very fine sand, or very fine sand

1304A—Glyndon very fine sandy loam

Composition

Glyndon and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Very fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 1.5 to 2.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Borup and similar soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Gonvick Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 3 percent

Taxonomic classification: Fine-loamy, mixed Aquic Argiborolls

Typical Pedon

Gonvick loam, 200 feet west and 1,600 feet north of the southeast corner of sec. 24, T. 132 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; common very fine and fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common very fine and fine roots; about 3 percent gravel; neutral; clear wavy boundary.

Bt1—15 to 25 inches; dark grayish brown (2.5Y 4/2) clay loam; strong medium subangular blocky structure; firm; common very fine and fine roots; common continuous prominent black (10YR 2/1) and common continuous prominent very dark gray

(10YR 3/1) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bt2—25 to 35 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium subangular blocky structure; firm; common very fine and fine roots; common continuous distinct very dark gray (10YR 3/1) and few continuous prominent black (10YR 2/1) clay films on faces of peds; common fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; about 3 percent gravel; neutral; clear wavy boundary.

Bk—35 to 47 inches; light olive brown (2.5Y 5/4) loam; weak fine and medium subangular blocky structure; friable; many fine and medium prominent gray (10YR 5/1) Fe depletions and few fine prominent yellowish brown (10YR 5/6) Fe concentrations; common soft masses of iron-manganese; common light gray (10YR 7/2) soft masses of carbonates; about 5 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—47 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; many medium and coarse distinct grayish brown (2.5Y 5/2) Fe depletions and common medium distinct light olive brown (2.5Y 5/6) Fe concentrations; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 38 inches

Thickness of the mollic epipedon: 8 to 16 inches

Content of rock fragments: 2 to 8 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam or clay loam

Bk horizon:

Hue—2.5Y or 10YR

Value—5 or 6

Chroma—2 to 4

Texture—loam

C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—loam or clay loam

180—Gonvick loam

Composition

Gonvick and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.8 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forman and similar soils
- Parnell and similar soils
- Buse and similar soils
- Roliss and similar soils
- Poorly drained soils
- Areas that have slopes of more than 3 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Grimstad Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; next part—rapid; lower part—moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over glacial till

Slope range: 0 to 3 percent

Taxonomic classification: Sandy over loamy, frigid Aeric Calciaquolls

Typical Pedon

Grimstad fine sandy loam, 2,250 feet east and 180 feet south of the northwest corner of sec. 30, T. 133 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—10 to 15 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; weak fine subangular blocky structure; friable; few fine and very fine roots; few faint light brownish gray (2.5Y 6/2) carbonate coatings on faces of peds; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—15 to 27 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; single grain; loose; few faint light brownish gray (2.5Y 6/2) carbonate coatings on faces of peds; about 1 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

C1—27 to 38 inches; light olive brown (2.5Y 5/4) loamy sand; single grain; loose; few fine distinct grayish brown (2.5Y 5/2) Fe depletions; slightly effervescent; moderately alkaline; clear wavy boundary.

2C2—38 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; common medium distinct grayish brown (2.5Y 5/2) and common medium prominent strong brown (7.5YR 4/6) Fe concentrations; about 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 16 inches

Depth to glacial till: 20 to 40 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 to 3

Texture—loamy sand, loamy fine sand, or loamy very fine sand

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—sand, fine sand, very fine sand, loamy sand, loamy fine sand, or loamy very fine sand

2C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—clay loam, silt loam, or silty clay loam
Content of rock fragments—1 to 10 percent

59—Grimstad fine sandy loam

Composition

Grimstad and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rockwell and similar soils
- Foldahl and similar soils
- Soils that have a leached surface layer

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hamerly Series

Depth class: Very deep

Drainage class: Moderately well drained and somewhat poorly drained

Permeability: Upper part—moderate; lower part—moderate or moderately slow

Landforms: Lake plains and moraines

Parent material: Till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, frigid Aeric Calciaquolls

Typical Pedon

Hamerly clay loam, in an area of Hamerly-Mustinka complex, 2,450 feet north and 700 feet west of the southeast corner of sec. 31, T. 131 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bky1—8 to 14 inches; olive (5Y 5/3) clay loam; weak medium subangular blocky structure; friable; common fine roots; common fine rounded light gray (10YR 7/2) soft masses of carbonates; common fine cylindrical gypsum crystals; about 2 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

Bky2—14 to 22 inches; olive gray (5Y 5/2) clay loam; weak medium subangular blocky structure; friable; few fine and very fine roots; common fine rounded light gray (10YR 7/2) soft masses of carbonates; common fine cylindrical gypsum crystals; about 2 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

Bky3—22 to 40 inches; light olive brown (2.5Y 5/4) clay loam; weak medium subangular blocky structure; firm; few very fine roots; few fine distinct grayish brown (2.5Y 5/2) Fe depletions and few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; common fine light gray (10YR 7/2) masses of carbonates; common fine cylindrical gypsum crystals; few soft shale fragments; about 2 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak medium and coarse prismatic soil fragments; firm; common medium distinct grayish

brown (2.5Y 5/2) Fe depletions and common fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 10 percent

A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—clay loam or loam

Bky horizon:

Hue—10YR, 2.5Y, or 5Y

Value—3 to 7

Chroma—1 to 4

Texture—loam or clay loam

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—loam or clay loam

184—Hamerly loam

Composition

Hamerly and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2 to 4 feet

Available water capacity to 60 inches or root-limiting

layer: About 10.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Barnes and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Poorly drained soils
- Soils in which carbonates have been leached to the subsoil
- Areas that have slopes of more than 3 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1149—Hamerly clay loam**Composition**

Hamerly and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landforms: Flats on lake plains and moraines
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Doran and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1259—Hamerly-Mustinka complex**Composition**

Hamerly and similar soils: About 60 percent
Mustinka and similar soils: About 25 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains
Position on the landform: Hamerly—slight rises;
Mustinka—flats and swales
Slope range: Hamerly—0 to 2 percent; Mustinka—0 to 1 percent

Component Description**Hamerly**

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: High

Mustinka

Texture of the surface layer: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Seasonal high water table: At the surface to 1 foot below the surface
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Foldahl and similar soils
- Aazdahl and similar soils
- Doran and similar soils

- Haug and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hangaard Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately rapid or rapid;
lower part—rapid or very rapid

Landform: Lakeshores

Parent material: Beach deposits

Slope range: 0 to 2 percent

Taxonomic classification: Sandy, mixed, frigid Typic
Endoaquolls

Taxadjunct features: The surface layer of the Hangaard soils in this county is loamy sand and is thinner than is defined as the range for the series.

Typical Pedon

Hangaard loamy sand, lake beaches, 7,525 feet east and 325 feet south of the northwest corner of sec. 7, T. 134 N., R. 39 W.

- A1—0 to 5 inches; black (10YR 2/1) loamy sand, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; loose; few fine and medium roots; slightly acid; clear smooth boundary.
- A2—5 to 8 inches; very dark grayish brown (10YR 3/2) sand, dark grayish brown (10YR 4/2) dry; single grain; loose; few fine and medium roots; slightly acid; clear smooth boundary.
- Cg1—8 to 23 inches; dark brownish gray (2.5Y 4/2) sand; single grain; loose; few fine and medium roots; common coarse prominent dark yellowish brown (10YR 4/4) Fe concentrations; about 5 percent gravel; neutral; clear smooth boundary.
- Cg2—23 to 28 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; many medium and coarse prominent dark yellowish brown (10YR 4/4) Fe concentrations; about 5 percent gravel; neutral; clear smooth boundary.
- Cg3—28 to 36 inches; grayish brown (10YR 5/2) gravelly coarse sand; single grain; loose; about 18 percent gravel; neutral; clear smooth boundary.

Cg4—36 to 46 inches; dark grayish brown (10YR 4/2) coarse sand; single grain; loose; about 10 percent gravel; neutral; clear smooth boundary.

Cg5—46 to 60 inches; light brownish gray (10YR 6/2) gravelly coarse sand; single grain; loose; about 19 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 46 inches

A or Ap horizon:

Hue—7.5YR, 10YR, or neutral

Value—2 to 4

Chroma—0 to 2

Texture—loamy sand

Content of rock fragments—0 to 15 percent

Cg horizon:

Hue—7.5YR to 5Y or neutral

Value—4 to 7

Chroma—0 to 2

Texture—fine sand, sand, loamy sand, loamy fine sand, gravelly sand, gravelly loamy sand, or stratified gravel and coarse sand

Content of rock fragments—5 to 35 percent

1114—Hangaard loamy sand, lake beaches

Composition

Hangaard and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lakeshores

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Beach deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 2.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corliss and similar soils
- Rushlake and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hantho Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate slow or moderate; lower part—moderate

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 1 to 3 percent

Taxonomic classification: Coarse-silty, mixed Pachic Udic Haploborolls

Typical Pedon

Hantho silt loam, 1,400 feet south and 350 feet west of the northeast corner of sec. 7, T. 134 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

A—9 to 22 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; many fine roots; neutral; clear wavy boundary.

Bw1—22 to 27 inches; brown (10YR 4/3) silt loam; moderate medium prismatic structure; friable; few fine roots; neutral; clear wavy boundary.

Bw2—27 to 31 inches; brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; few fine roots; neutral; clear wavy boundary.

Bk—31 to 43 inches; light olive brown (2.5Y 5/4) silt loam; moderate medium platy structure parting to weak fine subangular blocky; friable; few fine distinct grayish brown (2.5Y 5/2) Fe depletions and few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) carbonate threads; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/4) silt loam; weak thin plate-like soil fragments; friable;

common medium distinct grayish brown (2.5Y 5/2) Fe depletions and coarse medium prominent yellowish brown (10YR 5/6) Fe concentrations; few fine irregular light gray (10YR 7/2) carbonate threads; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 32 inches

Thickness of the mollic epipedon: 16 to 24 inches

Content of rock fragments: 0 to 2 percent throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 or 3

Texture—silt loam or very fine sandy loam

Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—silt loam, very fine sandy loam, or loam

C horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—silt loam, very fine sandy loam, or loam

497—Hantho silt loam

Composition

Hantho and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Swales on moraines

Position on the landform: Toeslopes

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 12.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lakepark and similar soils
- Lizzie and similar soils
- Rothsay and similar soils
- Soils that have carbonates above the subsoil
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Haslie Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—slow or moderately slow

Landforms: Outwash plains, moraines, and lake plains

Parent material: Organic materials and coprogenous earth

Slope range: 0 to 1 percent

Taxonomic classification: Coprogenous, euic Limnic Borosaprists

Typical Pedon

Haslie muck, 2,200 feet west and 2,100 feet south of the northeast corner of sec. 12, T. 133 N., R. 38 W.

Oa1—0 to 21 inches; muck (sapric material), black (10YR 2/1) broken face and very dark brown (10YR 2/2) rubbed; about 20 percent fiber, 3 percent rubbed; moderate medium granular structure; very friable; common fine and medium roots; very few small shells; very slightly effervescent; slightly alkaline; clear wavy boundary.

Oa2—21 to 24 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 10 percent fiber, 1 percent rubbed; weak medium subangular blocky structure; very friable; few small shells; strongly effervescent; slightly alkaline; clear wavy boundary.

Cg1—24 to 50 inches; brown (10YR 4/3) and dark grayish brown (2.5Y 4/2) mucky silt loam (coprogenous earth); weak fine subangular blocky structure; very friable; few small shells; violently effervescent; moderately alkaline; clear wavy boundary.

Cg2—50 to 60 inches; very dark gray (5Y 3/1) and dark gray (5Y 4/1) mucky silt loam (coprogenous earth); few small shells; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to coprogenous earth: 16 to 50 inches

Oa horizon:

Hue—10YR, 7.5YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 3

Texture—muck

Cg horizon:

Hue—10YR, 5Y, 2.5Y, or neutral

Value—2 to 6

Chroma—0 to 3

Texture—mucky silt loam or mucky silty clay loam

746—Haslie muck**Composition**

Haslie and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landforms: Depressions on lake plains and moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 17.5 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Epoufette and similar soils
- Egglake and similar soils
- Bluffton and similar soils
- Bluffcreek and similar soils
- Wykeham and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1113—Haslie, Seelyeville, and Cathro soils, ponded***Composition***

Haslie: Variable

Seelyeville: Variable

Cathro: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description**Haslie**

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 21.6 inches

Organic matter content: Very high

Seelyeville

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: Very high

Cathro

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 4.0 feet above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 20.0 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Knute and similar soils
- Brandsvold and similar soils
- Bluffton and similar soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

1230—Haslie and Nidaros soils, ponded***Composition***

Haslie and similar soils: About 45 percent

Nidaros and similar soils: About 45 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains

Slope range: 0 to 1 percent

Component Description**Haslie**

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials and coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 21.6 inches

Organic matter content: Very high

Nidaros

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over outwash

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 18.3 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hangaard and similar soils
- Pinelake and similar soils
- Leafriver and similar soils
- Rushlake and similar soils
- Corliss and similar soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

Haug Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Lake plains

Parent material: Organic materials over till

Slope range: 0 to 1 percent

Taxonomic classification: Coarse-loamy, mixed (calcareous), frigid Histic Humaquepts

Typical Pedon

Haug muck, 1,050 feet east and 700 feet north of the southwest corner of sec. 19, T. 135 N., R. 46 W., in Wilkin County, Minnesota:

Oa—0 to 14 inches; black (10YR 2/1) muck; about 20 percent fiber unrubbed, 2 percent rubbed; weak very fine granular structure; very friable; slightly effervescent; slightly alkaline; gradual smooth boundary.

A—14 to 20 inches; very dark gray (5Y 3/1) loam, dark gray (5Y 4/1) dry; weak very fine granular structure; friable; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg—20 to 60 inches; gray (5Y 5/1) silt loam; massive; friable; common medium and coarse prominent brownish yellow (10YR 6/6) and light olive brown (2.5Y 5/6) Fe concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the histic epipedon: 8 to 16 inches

Oa horizon:

Hue—5YR to 10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

A horizon:

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loam, sandy loam, fine sandy loam, sandy clay loam, or silt loam or the mucky analogs of these textures

Content of rock fragments—0 to 15 percent

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 7

Chroma—1 or 2

Texture—silt loam, loam, sandy clay loam, fine sandy loam, or sandy loam

Content of rock fragments—0 to 15 percent

187—Haug muck

Composition

Haug and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Swales and depressions on lake plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.9 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Vallery and similar soils
- Arveson and similar soils
- Cathro and similar soils
- Soils that formed in outwash

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Heimdal Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic classification: Coarse-loamy, mixed Udic Haploborolls

Typical Pedon

Heimdal loam, in an area of Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded, 1,050 feet east and 80 feet north of the southwest corner of sec. 17, T. 132 N., R. 42 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Bw—7 to 17 inches; dark yellowish brown (10YR 3/4) loam; moderate medium subangular blocky structure; friable; common fine roots; about 5 percent gravel; neutral; clear smooth boundary.

Bk—17 to 34 inches; light olive brown (2.5Y 5/4) sandy loam; weak medium subangular blocky structure; friable; many very pale brown (10YR 7/3) carbonate coatings in pores; about 5 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; moderate medium platy soil fragments; friable; few distinct very pale brown (10YR 7/3) carbonate coatings in pores; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 12 to 26 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 10 percent throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loam

Bw horizon:

Hue—10YR

Value—2 to 5

Chroma—2 to 4

Texture—loam, sandy loam, or fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam, sandy loam, or fine sandy loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 4

Texture—loam, fine sandy loam, or sandy loam

1324B—Heimdal-Sisseton complex, 2 to 6 percent slopes

Composition

Heimdal and similar soils: About 60 percent

Sisseton and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Heimdal

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches
Organic matter content: High

Sisseton

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darnen and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hillview Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—moderate or moderately rapid
Landforms: Pitted outwash plains and moraines
Parent material: Glaciofluvial deposits
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, frigid Mollic Endoaqualfs

Typical Pedon

Hillview fine sandy loam, 200 feet south and 1,075 feet west of the northeast corner of sec. 30, T. 137 N., R. 36 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; common very fine and fine roots; strongly acid; abrupt smooth boundary.

Eg—7 to 15 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium and coarse subangular blocky structure; friable; common very fine and fine roots; few fine faint light olive brown (2.5Y 5/3) Fe concentrations; strongly acid; clear smooth boundary.

Btg1—15 to 22 inches; light brownish gray (2.5Y 6/2) loam; moderate medium and coarse subangular blocky structure; friable; few fine roots; many continuous faint grayish brown (2.5Y 5/2) clay films on faces of peds; few fine prominent dark brown (7.5YR 4/4) Fe concentrations; strongly acid; clear smooth boundary.

Btg2—22 to 29 inches; light brownish gray (2.5Y 6/2) loam; moderate medium and coarse subangular blocky structure; friable; few fine roots; few patchy faint light yellowish brown (2.5Y 6/3) clay films on faces of peds; few fine prominent dark brown (7.5YR 4/4) and common medium prominent brown (7.5YR 5/4) Fe concentrations; strongly acid; abrupt smooth boundary.

Cg—29 to 60 inches; stratified gray (10YR 6/1) fine sandy loam, light olive brown (2.5Y 5/3) silt loam, and light brownish gray (2.5Y 6/2) loamy very fine sand; massive breaking to thin platy fragments along depositional varves; very friable; few fine roots; many coarse and fine prominent yellowish brown (10YR 5/6) Fe concentrations; few red (2.5YR 4/6) cylindrical soft masses of iron; strongly acid.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Content of rock fragments: 0 to 5 percent throughout

A or Ap horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Eg horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2

Texture—loamy fine sand, loamy sand, fine sandy loam, fine sand, or sandy loam

Btg horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—1 or 2

Texture—dominantly loam, sandy loam, fine sandy loam, or very fine sandy loam; subhorizons that have more sand or clay in some pedons

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—stratified very fine sandy loam, loamy very fine sand, and fine sand

1365—Hillview fine sandy loam**Composition**

Hillview and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Flats on moraines and outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciofluvial deposits

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.1 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Rosy and similar soils
- Epoufette and similar soils
- Forada and similar soils
- Borup and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Hubbard Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 12 percent

Taxonomic classification: Sandy, mixed Udorthentic Haploborolls

Typical Pedon

Hubbard loamy sand, 2 to 6 percent slopes, 1,525 feet south and 650 feet west of the northeast corner of sec. 31, T. 134 N., R. 39 W.

Ap—0 to 8 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many very fine and fine roots; moderately acid; abrupt smooth boundary.

A—8 to 12 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; many very fine and fine roots; moderately acid; abrupt smooth boundary.

Bw—12 to 17 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 4/3) dry; weak fine subangular blocky structure; very friable; few very fine roots; moderately acid; about 1 percent gravel; moderately acid; clear smooth boundary.

BC—17 to 42 inches; dark yellowish brown (10YR 4/4)

sand; single grain; few very fine roots; loose; about 1 percent gravel; slightly acid; clear smooth boundary.

C1—42 to 58 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; about 5 percent gravel; slightly acid; clear smooth boundary.

C2—58 to 60 inches; yellowish brown (10YR 4/4) coarse sand; single grain; loose; about 10 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

Thickness of the mollic epipedon: 10 to 26 inches

Content of rock fragments: 0 to 10 percent throughout

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—2 to 4

Texture—coarse sand, loamy coarse sand, or loamy sand

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 5

Texture—coarse sand or sand

7A—Hubbard loamy sand, 0 to 2 percent slopes

Composition

Hubbard and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats and slight rises on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Duelm and similar soils
- Oylen and similar soils
- Verndale and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

7B—Hubbard loamy sand, 2 to 6 percent slopes

Composition

Hubbard and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Duelm and similar soils
- Oylen and similar soils
- Verndale and similar soils
- Areas that have slopes of more than 6 percent
- Poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

7C—Hubbard loamy sand, 6 to 12 percent slopes***Composition***

Hubbard and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.5 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Corliss and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

- Poorly drained soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Isan Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 1 percent
Taxonomic classification: Sandy, mixed, frigid Typic Endoaquolls

Typical Pedon

Isan sandy loam, 1,075 feet north and 225 feet east of the southwest corner of sec. 16, T. 136 N., R. 39 W.

- Ap—0 to 9 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; very friable; common very fine and fine roots; neutral; abrupt smooth boundary.
- A—9 to 16 inches; very dark grayish brown (10YR 3/2) loamy sand, gray (10YR 5/1) dry; weak very fine and fine subangular blocky structure; very friable; few fine roots; clear smooth boundary.
- Bg—16 to 26 inches; dark grayish brown (10YR 4/2) loamy sand; weak very fine and fine subangular blocky structure; very friable; few fine prominent olive brown (2.5Y 4/4) Fe concentrations and few fine faint dark gray (10YR 4/1) Fe depletions; neutral; clear smooth boundary.
- Cg1—26 to 38 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; few fine faint light olive brown (2.5Y 5/3) Fe concentrations; neutral; clear smooth boundary.
- Cg2—38 to 52 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; common faint medium light olive brown (2.5Y 5/3) Fe concentrations; about 3 percent gravel; neutral; abrupt smooth boundary.

Cg3—52 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; neutral.

Range in Characteristics

Depth to carbonates: Greater than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches
Content of rock fragments: 0 to 10 percent gravel

A or Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
 Value—2 or 3
 Chroma—0 to 2
 Texture—sandy loam

Bg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
 Value—4 or 5
 Chroma—0 to 2
 Texture—sand, coarse sand, loamy coarse sand, or loamy sand

C horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—sand or coarse sand

1110—Isan sandy loam

Composition

Isan and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Leafriver and similar soils
- Nidaros and similar soils
- Duelm and similar soils
- Hubbard and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kandota Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 20 percent

Taxonomic classification: Fine-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Kandota sandy loam, 2 to 6 percent slopes, 650 feet south and 100 feet west of the northeast corner of sec. 21, T. 135 N., R. 38 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; weak fine granular structure; friable; common very fine and fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

E—8 to 11 inches; brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak medium platy structure; very friable; common very fine and fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—11 to 22 inches; brown (10YR 4/3) sandy clay loam; moderate medium angular blocky structure; friable; few very fine roots; common discontinuous faint very dark grayish brown (10YR 3/2) and few discontinuous faint dark brown (10YR 3/3) clay films on faces of peds and in pores; few discontinuous distinct very pale brown (10YR 7/3) very fine sand coatings on faces of peds; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bt2—22 to 32 inches; brown (10YR 4/3) sandy loam; moderate medium subangular blocky structure;

friable; few patchy faint dark brown (10YR 3/3) clay films on faces of peds; very few discontinuous distinct very pale brown (10YR 7/3) very fine sand coatings on faces of peds; about 3 percent gravel; neutral; clear smooth boundary.

Bk—32 to 68 inches; light olive brown (2.5Y 5/4) sandy loam; weak medium subangular blocky structure; friable; common discontinuous fine and medium light gray (10YR 7/2) carbonate threads throughout; about 7 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—68 to 80 inches; light olive brown (2.5Y 5/4) sandy loam; moderate medium and thin platy soil aggregates; massive; friable; about 7 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches

Content of rock fragments: 1 to 15 percent

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, or loamy sand

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—sandy clay loam, sandy loam, fine sandy loam, or clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam, fine sandy loam, or loam

53B—Kandota sandy loam, 2 to 6 percent slopes

Composition

Kandota and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Brandsvold and similar soils
- Bluffton and similar soils
- Knute and similar soils
- Soils that formed in outwash
- Areas that have stones on the surface
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

53C—Kandota sandy loam, 6 to 12 percent slopes

Composition

Kandota and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Brandsvold and similar soils
- Bluffton and similar soils
- Areas that have stones on the surface
- Soils that formed in outwash
- Areas that have slopes of more than 12 percent or less than 6 percent
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

53D—Kandota sandy loam, 12 to 20 percent slopes

Composition

Kandota and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Brandsvold and similar soils
- Bluffton and similar soils
- Areas that have stones on the surface
- Soils that formed in outwash
- Areas that have slopes of more than 20 percent or less than 12 percent
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1275B—Kandota-Egglake, depressional, complex, 0 to 8 percent slopes**Composition**

Kandota and similar soils: About 60 percent

Egglake and similar soils: About 25 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Kandota—summits and backslopes; Egglake—depressions

Slope range: Kandota—1 to 8 percent; Egglake—0 to 1 percent

Component Description**Kandota**

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: Moderate

Egglake

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cathro and similar soils
- Brandsvold and similar soils
- Knute and similar soils
- Areas that have slopes of more than 8 percent
- Areas that have stones on the surface
- Soils that are underlain by outwash

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1275C—Kandota-Egglake, depressional, complex, 0 to 15 percent slopes**Composition**

Kandota and similar soils: About 55 percent

Egglake and similar soils: About 30 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Kandota—backslopes and shoulders; Egglake—depressions

Slope range: Kandota—8 to 15 percent; Egglake—0 to 1 percent

Component Description**Kandota**

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.5 inches

Organic matter content: Moderate

Egglake

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 10.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cathro and similar soils
- Brandsvold and similar soils
- Knute and similar soils
- Areas that have slopes of more than 15 percent
- Areas that have stones on the surface
- Soils that are underlain by outwash

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1347B—Kandota loam, 1 to 6 percent slopes

Composition

Kandota and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Bluffton and similar soils
- Knute and similar soils
- Naytahwaush and similar soils
- Areas that have stones on the surface
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Kittson Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderately slow or moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed Aquic Haploborolls

Typical Pedon

Kittson loam, 1,000 feet north and 800 feet west of the southeast corner of sec. 30, T. 131 N., R. 44 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; common fine and very fine roots; neutral; abrupt smooth boundary.

Bw—7 to 18 inches; olive brown (2.5Y 4/3) loam; common fine and medium prominent dark yellowish brown (10YR 4/4) Fe concentrations; moderate medium subangular blocky structure; friable; common fine and very fine roots; neutral; gradual wavy boundary.

2Bk—18 to 32 inches; olive brown (2.5Y 5/3) clay loam; moderate medium subangular blocky structure; firm; few very fine roots; common fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; common fine irregular light gray

(10YR 7/2) carbonate concretions; about 2 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

2C—32 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; about 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Depth to loamy glacial till: 14 to 30 inches

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Content of rock fragments—0 to 10 percent

Bw horizon:

Hue—10YR or 2.5Y

Value—3 or 4

Chroma—2 or 3

Texture—loam, sandy loam, very fine sandy loam, sandy clay loam, or loamy sand

Content of rock fragments—0 to 35 percent

2Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam, clay loam, or sandy loam

Content of rock fragments—2 to 10 percent

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

Content of rock fragments—2 to 10 percent

58—Kittson loam

Composition

Kittson and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.4 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mustinka and similar soils
- Hamerly and similar soils
- Soils that have more clay in the subsoil than the Kittson soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Knute Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 0 to 3

Taxonomic classification: Fine-loamy, mixed Aquic Argiborolls

Typical Pedon

Knute fine sandy loam, 1,200 feet south and 2,550 feet west of the northeast corner of sec. 9, T. 136 N., R. 43 W.

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

Bt—9 to 22 inches; brown (10YR 4/3) sandy clay loam; weak medium prismatic structure grading to moderate fine and medium subangular blocky; firm; few fine and very fine roots; common discontinuous faint very dark grayish brown (10YR 3/2) clay films on faces of peds; about 4 percent gravel; neutral; abrupt wavy boundary.

Bk—22 to 29 inches; light olive brown (2.5Y 5/4) loam; weak fine and medium subangular blocky structure; friable; few fine and very fine roots; few fine distinct grayish brown (2.5Y 5/2) Fe depletions; many continuous prominent light gray (10YR 7/2) carbonate coatings on faces of peds; about 5 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

C—29 to 60 inches; light olive brown (2.5Y 5/6) loam; massive; friable; common fine and medium distinct grayish brown (2.5Y 5/2) Fe depletions; few fine light gray (10YR 7/2) carbonate threads; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 60 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 2 to 10 percent throughout

A or Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sandy loam, sandy loam, or loam

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—2 to 4

Texture—sandy clay loam, fine sandy loam, loam, or sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—fine sandy loam, loam, or sandy loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—fine sandy loam, loam, or sandy loam

670—Knut fine sandy loam

Composition

Knut and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.3 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Chapett and similar soils
- Brandsvold and similar soils
- Weetown and similar soils
- Bluffton and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1276—Knut-Brandsvold complex, thick solum

Composition

Knut and similar soils: About 60 percent

Brandsvold and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Knute—footslopes and toeslopes; Brandsvold—drainageways and flats

Slope range: Knute—0 to 3 percent; Brandsvold—0 to 2 percent

Component Description

Knute

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.3 inches

Organic matter content: Moderate

Brandsvold

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.3 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1289—Knute fine sandy loam, thick solum

Composition

Knute and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.6 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Mahkonce and similar soils
- Brandsvold and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1348—Knut loam, thick solum**Composition**

Knut and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Bluffton and similar soils
- Mahkonce and similar soils
- Kandota and similar soils
- Areas that have stones on the surface
- Areas that have slopes of more than 3 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Kratka Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderately rapid; next part—rapid; lower part—moderately slow or moderate

Landforms: Lake plains and moraines

Parent material: Glaciolacustrine deposits over till or glacial outwash over till

Slope range: 0 to 2 percent

Taxonomic classification: Sandy over loamy, mixed, frigid Typic Endoaquolls

Typical Pedon

Kratka fine sandy loam, 1,150 feet east and 1,200 feet north of the southwest corner of sec. 19, T. 131 N., R. 44 W.

Ap—0 to 9 inches; black (N 2/0) fine sandy loam, very dark gray (N 3/0) dry; weak fine and medium subangular blocky structure; very friable; common fine and medium roots; neutral; abrupt smooth boundary.

Bg1—9 to 17 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; weak fine subangular blocky structure; very friable; common fine and very fine roots; common fine distinct light olive brown (2.5Y 5/6) Fe concentrations; neutral; clear wavy boundary.

Bg2—17 to 25 inches; grayish brown (2.5Y 5/2) fine sand; single grain; loose; few fine and very fine roots; common fine distinct light olive brown (2.5Y 5/6) Fe concentrations; neutral; abrupt wavy boundary.

2Bgk—25 to 40 inches; light brownish gray (2.5Y 6/2) clay loam; moderate fine and medium prismatic structure; firm; few very fine roots; common fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations; common medium irregular light gray (10YR 7/2) carbonate threads; few fine irregular iron-manganese concretions; about 2 percent gravel; violently effervescent; moderately alkaline; clear wavy boundary.

2Cg—40 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; common fine and medium distinct yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 8 to 18 inches

Depth to glacial till: 20 to 40 inches

A horizon:

Hue—2.5Y, 10YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sandy loam
Content of rock fragments—0 to 5 percent

Bg horizon:

Hue—2.5Y or 10YR
Value—4 to 6
Chroma—1 or 2
Texture—loamy fine sand, fine sand, loamy sand, or sand
Content of rock fragments—0 to 5 percent

2Bkg horizon:

Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—clay loam or loam
Content of rock fragments—0 to 5 percent

2Cg horizon:

Hue—10YR to 5Y
Value—4 to 6
Chroma—1 to 3
Texture—clay loam, loam, silt loam, or silty clay loam
Content of rock fragments—0 to 8 percent

481—Kratka fine sandy loam

Composition

Kratka and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landforms: Flats and rises on lake plains and moraines
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 8.0 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Wolverton and similar soils
- Foldahl and similar soils
- Soils that have carbonates above the subsoil
- Soils in which the till is at a greater depth than in the Kratka soil
- Well drained soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

726—Kratka sandy loam, thick solum, depressional

Composition

Kratka and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash over till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 7.4 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Clitherall and similar soils
- Pinelake and similar soils

- Brandsvold and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lakepark Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landform: Moraines

Parent material: Colluvium over till

Slope range: 1 to 3 percent

Taxonomic classification: Fine-loamy, mixed, frigid
Cumulic Endoaquolls

Typical Pedon

Lakepark loam, 2,100 feet south and 1,100 feet west of the northeast corner of sec. 1, T. 133 N., R. 44 W.

Ap—0 to 9 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; common fine and medium roots; neutral; clear smooth boundary.

A1—9 to 22 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; common fine roots; about 1 percent gravel; neutral; clear wavy boundary.

A2—22 to 35 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; few fine roots; about 1 percent gravel; neutral; clear wavy boundary.

Bg—35 to 44 inches; grayish brown (2.5Y 5/2) clay loam; weak medium subangular blocky structure; firm; common medium prominent yellowish brown (10YR 5/6) Fe concentrations; few patchy distinct very dark grayish brown (10YR 3/2) organic coatings on faces of peds; few fine roots; about 2 percent gravel; neutral; clear wavy boundary.

Bkg—44 to 53 inches; light brownish gray (2.5Y 6/2) loam; weak medium subangular blocky structure; friable; common medium distinct light olive brown (2.5Y 5/6) Fe concentrations; many fine faint light gray (2.5Y 7/2) carbonate coatings on faces of peds; about 2 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

Cg—53 to 60 inches; light brownish gray (2.5Y 6/2) loam; massive; friable; many medium prominent yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 25 to 50 inches

Thickness of the mollic epipedon: 24 to 60 inches

Content of rock fragments: 1 to 8 percent throughout

A horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Bg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—clay loam, silty clay loam, or loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam or clay loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—loam or clay loam

1237—Lakepark loam

Composition

Lakepark and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Colluvium over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.2 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darnen and similar soils
- Hamerly and similar soils
- Barnes and similar soils
- Parnell and similar soils
- Quam and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lamoure Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow or moderate

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent

Taxonomic classification: Fine-silty, mixed (calcareous), frigid Cumulic Endoaquolls

Typical Pedon

Lamoure silty clay loam, occasionally flooded, 550 feet south and 220 feet west of the northeast corner of sec. 11, T. 136 N., R. 47 W., in Wilkin County, Minnesota:

A1—0 to 18 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly effervescent; moderately alkaline; gradual smooth boundary.

A2—18 to 32 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; slightly effervescent; moderately alkaline; clear smooth boundary.

Cg1—32 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; weak thin platy soil fragments; friable; few fine prominent olive (5Y 5/6) Fe concentrations; few medium very dark gray (2.5Y 3/1) stains; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg2—40 to 48 inches; gray (5Y 4/2) silt loam; weak

thin platy soil fragments; friable; few fine distinct olive brown (2.5Y 5/4) Fe concentrations; strongly effervescent; moderately alkaline; clear wavy boundary.

Cg3—48 to 60 inches; dark gray (2.5Y 4/1) and gray (2.5Y 5/1), stratified silt loam and very fine sand; massive; friable; few fine prominent yellowish brown (10YR 5/8) Fe concentrations; very dark gray (2.5Y 3/1) stains; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 24 to 60 inches

Content of rock fragments: Typically none throughout

A horizon:

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam

Cg1 and Cg2 horizons:

Hue—2.5Y or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—silty clay loam or silt loam

Cg3 horizon:

Hue—2.5Y or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—stratified silt loam and very fine sand

418—Lamoure silty clay loam, occasionally flooded

Composition

Lamoure and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats on flood plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Alluvium

Frequency of flooding: Occasional

Seasonal high water table: At the surface to 1.5 feet below the surface

Available water capacity to 60 inches or root-limiting layer: About 11.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arveson and similar soils
- Sedgewille and similar soils
- Areas that are frequently flooded
- Soils that are underlain by outwash
- Areas that are subject to only rare flooding

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Langhei Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 6 to 20 percent

Taxonomic classification: Fine-loamy, mixed, frigid
Typic Eutrochrepts

Typical Pedon

Langhei loam, in an area of Barnes-Langhei complex, 6 to 12 percent slopes, eroded, 1,250 feet west and 2,500 feet south of the northeast corner of sec. 28, T. 134 N., R. 44 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; few fine roots; about 5 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—7 to 13 inches; light yellowish brown (2.5Y 6/4) loam; weak medium subangular blocky structure; friable; few fine roots; many fine irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—13 to 30 inches; light olive brown (2.5Y 5/4) loam; few patchy prominent yellowish brown

(10YR 5/6) iron stains in root channels; weak medium subangular blocky structure; friable; many fine irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C—30 to 60 inches; light olive brown (2.5Y 5/4) loam; few patchy prominent yellowish brown (10YR 5/6) iron stains in root channels; massive; friable; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface

Content of rock fragments: 2 to 10 percent

Ap horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—1 or 2

Texture—loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or clay loam

C horizon:

Hue—2.5Y

Value—4 to 7

Chroma—2 to 4

Texture—loam or clay loam

942D2—Langhei-Barnes complex, 12 to 20 percent slopes, eroded**Composition**

Langhei and similar soils: About 55 percent

Barnes and similar soils: About 35 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description**Langhei**

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches
Organic matter content: Moderately low

Barnes

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lakepark and similar soils
- Cathro and similar soils
- Parnell and similar soils
- Roliss and similar soils
- Darnen and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Leaflake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—rapid; lower part—moderate
Landform: Moraines
Parent material: Eolian deposits over till
Slope range: 1 to 20 percent
Taxonomic classification: Loamy, mixed Arenic Eutroboralfs

Typical Pedon

Leaflake loamy sand, in an area of Leaflake-Eagleview complex, 1 to 6 percent slopes, 2,600 feet south and

850 feet west of the northeast corner of sec. 31, T. 134 N., R. 38 W.

- Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; very friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.
- E1—8 to 12 inches; dark grayish brown (10YR 4/2) sand, grayish brown (10YR 5/2) dry; single grain; loose; few very fine roots; common discontinuous distinct very dark gray (10YR 3/1) organic coatings on faces of peds; slightly acid; clear smooth boundary.
- E2—12 to 26 inches; brown (10YR 5/3) sand, pale brown (10YR 6/3) dry; single grain; loose; few very fine roots; neutral; clear smooth boundary.
- 2Bt1—26 to 38 inches; dark yellowish brown (10YR 4/4) sandy clay loam; strong medium subangular blocky structure; friable; few continuous distinct very dark brown (10YR 2/2) and common continuous distinct dark brown (10YR 3/3) clay films on faces of peds and few patchy distinct dark brown (7.5YR 3/2) clay films on faces of peds and in pores; about 3 percent gravel; slightly acid; clear smooth boundary.
- 2Bt2—38 to 51 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; friable; common discontinuous distinct dark brown (10YR 3/3) and brown (10YR 4/3) clay films on faces of peds; about 3 percent gravel; slightly acid; clear smooth boundary.
- 2C1—51 to 62 inches; light yellowish brown (2.5Y 6/4) sandy loam; moderate medium and thin platy soil fragments; friable; very few patchy prominent light gray (10YR 7/2) carbonate coatings on horizontal faces of peds; about 3 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.
- 2C2—62 to 80 inches; light olive brown (2.5Y 5/4) sandy loam; massive parting to moderate thin platy soil fragments; friable; about 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 35 to 72 inches
Thickness of the sandy mantle: 20 to 40 inches
Content of rock fragments: Typically none in the upper part; 1 to 15 percent in the glacial till
Other features: The combined thickness of the 2Bt horizons ranges from 7 to 32 inches.

Ap horizon:

Hue—10YR or 7.5YR

Value—2 to 4
 Chroma—1 to 3
 Texture—loamy sand

E horizon:

Hue—10YR
 Value—4 or 5
 Chroma—2 or 3
 Texture—sand, fine sand, loamy sand, or loamy fine sand

2Bt horizon:

Hue—10YR
 Value—4 or 5
 Chroma—3 or 4
 Texture—sandy clay loam, fine sandy loam, sandy loam, or loam

2C horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 4
 Texture—loam, sandy loam, or fine sandy loam

716B—Leaflake-Eagleview complex, 1 to 6 percent slopes

Composition

Leaflake and similar soils: About 55 percent
 Eagleview and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 6 percent

Component Description

Leaflake

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Eolian deposits over till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 7.2 inches
Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Nitché and similar soils
- Kandota and similar soils
- Bluffton and similar soils
- Bemidji and similar soils
- Kratka and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

716C—Leaflake-Eagleview complex, 6 to 12 percent slopes

Composition

Leaflake and similar soils: About 55 percent
 Eagleview and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Leaflake

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Eolian deposits over till
Flooding: None
Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.6 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Nitché and similar soils
- Kandota and similar soils
- Bluffton and similar soils
- Bemidji and similar soils
- Kratka and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

716D—Leaflake-Eagleview complex, 12 to 20 percent slopes

Composition

Leaflake and similar soils: About 55 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description

Leaflake

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Eolian deposits over till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.3 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.5 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Nitché and similar soils
- Kandota and similar soils
- Bluffton and similar soils
- Bemidji and similar soils
- Kratka and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Leafriver Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate or moderately

rapid; next part—moderately rapid or rapid; lower part—rapid

Landform: Pitted outwash plains

Parent material: Organic materials over outwash or lacustrine deposits

Slope range: 0 to 1 percent

Taxonomic classification: Sandy, mixed, frigid Histic Humaquepts

Typical Pedon

Leafriver muck, in an area of Forada and Leafriver soils, depressional, 1,300 feet west and 850 feet south of the northeast corner of sec. 11, T. 133 N., R. 40 W.

Oa—0 to 12 inches; muck (sapric material), black (N 2/0) broken face and rubbed; moderate medium subangular blocky structure; friable; many fine and medium roots; neutral; clear wavy boundary.

A—12 to 20 inches; black (10YR 2/1) loamy sand; weak fine granular structure; very friable; neutral; clear wavy boundary.

Cg—20 to 60 inches; dark gray (5Y 4/1) sand; massive; loose; neutral.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

Thickness of the histic epipedon: 8 to 16 inches

Content of rock fragments: 0 to 15 percent in the mineral soil

Oa horizon:

Hue—10YR to 5YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

A horizon:

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 to 2

Texture—fine sand, loamy sand, or sandy loam or the mucky analogs of these textures

Cg horizon:

Hue—10YR to 5GY

Value—4 to 7

Chroma—1 or 2

Texture—loamy sand, fine sand, sand, or stratified with thin layers of loamy materials

Lida Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid or very rapid

Landforms: Kame moraines and pitted outwash plains

Parent material: Glacial outwash

Slope range: 1 to 50 percent

Taxonomic classification: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Lida sandy loam (fig. 16), in an area of Lida-Two Inlets complex, 8 to 15 percent slopes, 1,450 feet west and 750 feet south of the northeast corner of sec. 5, T. 137 N., R. 40 W.

A1—0 to 2 inches; black (10YR 2/1) sandy loam, very dark brown (10YR 2/2) dry; weak fine and medium granular structure; very friable; many very fine and fine roots; about 3 percent gravel; neutral; clear smooth boundary.

A2—2 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine and medium subangular blocky structure; very friable; common very fine and fine roots; about 6 percent gravel; neutral; abrupt wavy boundary.

E—8 to 17 inches; grayish brown (10YR 5/2) loamy sand, light gray (10YR 7/2) dry; weak medium and coarse subangular blocky structure; friable; few very fine and fine roots; about 8 percent gravel; neutral; clear wavy boundary.

Bt1—17 to 25 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; moderate medium and coarse subangular blocky structure; firm; few very fine and fine roots; many continuous faint brown (10YR 4/3) clay films on faces of peds and in pores; about 16 percent gravel; neutral; clear wavy boundary.

Bt2—25 to 36 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; moderate fine and medium subangular blocky structure; friable; few very fine and fine roots; common discontinuous faint brown (10YR 4/3) clay bridging on sand and gravel; about 17 percent gravel; slightly acid; gradual wavy boundary.

Bt3—36 to 41 inches; brown (10YR 4/3) gravelly loamy sand; moderate fine and medium subangular blocky structure; friable; few very fine and fine roots; many continuous faint dark brown (10YR 3/3) clay bridging on sand and gravel; about 15 percent gravel; neutral; abrupt wavy boundary.

C—41 to 80 inches; brown (10YR 5/3) gravelly sand; single grain; loose; about 18 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 27 to 60 inches

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 to 3
 Texture—sandy loam
 Content of rock fragments—0 to 10 percent

E horizon:

Hue—10YR
 Value—4 or 5
 Chroma—2 to 4
 Texture—sand, loamy sand, loamy coarse sand, loamy fine sand, or sandy loam
 Content of rock fragments—0 to 10 percent

Bt horizon:

Hue—7.5YR or 10YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—dominantly sandy loam, coarse sandy loam, or the gravelly analogs of these textures; subhorizons of loamy sand, sandy clay loam, loamy coarse sand, or loam or the gravelly or very gravelly analogs of these textures in some pedons
 Content of rock fragments—10 to 35 percent

Bk horizon:

Hue—10YR, 2.5Y, or 7.5YR
 Value—4 to 7
 Chroma—2 to 6
 Texture—dominantly loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures; very gravelly in subhorizons of some pedons
 Content of rock fragments—10 to 35 percent

C horizon:

Hue—10YR, 2.5Y, or 7.5YR
 Value—4 to 7
 Chroma—2 to 6
 Texture—dominantly sand, coarse sand, gravelly sand, or gravelly coarse sand; very gravelly in subhorizons of some pedons
 Content of rock fragments—10 to 35 percent

1196B—Lida-Two Inlets complex, 1 to 8 percent slopes

Composition

Lida and similar soils: About 65 percent
 Two Inlets and similar soils: About 20 percent
 Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 1 to 8 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.1 inches
Organic matter content: Moderate

Two Inlets

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Areas that have stones on the surface
- Nidaros and similar soils
- Areas that have slopes of more than 8 percent or less than 1 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1196C—Lida-Two Inlets complex, 8 to 15 percent slopes

Composition

Lida and similar soils: About 60 percent
Two Inlets and similar soils: About 25 percent
Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains

Position on the landform: Backslopes and shoulders
Slope range: 8 to 15 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.9 inches
Organic matter content: Moderate

Two Inlets

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Areas that have stones on the surface
- Nidaros and similar soils

- Areas that have slopes of more than 15 percent or less than 8 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1196E—Lida-Two Inlets complex, 15 to 30 percent slopes

Composition

Lida and similar soils: About 60 percent
Two Inlets and similar soils: About 25 percent
Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 15 to 30 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: Moderate

Two Inlets

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Areas that have stones on the surface
- Nidaros and similar soils
- Areas that have slopes of more than 30 percent or less than 15 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1196F—Lida-Two Inlets complex, 30 to 50 percent slopes

Composition

Lida and similar soils: About 45 percent
Two Inlets and similar soils: About 40 percent
Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 30 to 50 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: Moderate

Two Inlets

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 2.9 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Areas that have stones on the surface
- Nidaros and similar soils
- Areas that have slopes of less than 30 percent

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1343C—Lida-Almora-Lizzie complex, 8 to 15 percent slopes

Composition

Lida and similar soils: About 35 percent
Almora and similar soils: About 30 percent
Lizzie and similar soils: About 20 percent
Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains
Position on the landform: Lida—backslopes and shoulders; Almora—footslopes and toeslopes; Lizzie—backslopes and shoulders
Slope range: 8 to 15 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: Moderate

Almora

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.6 inches
Organic matter content: High

Lizzie

Texture of the surface layer: Very fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Two Inlets and similar soils
- Bluffcreek and similar soils
- Dent and similar soils
- Oakcreek and similar soils
- Pinelake and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1344B—Lida-Almora-Dent complex, 1 to 8 percent slopes

Composition

Lida and similar soils: About 35 percent
 Almora and similar soils: About 30 percent
 Dent and similar soils: About 20 percent
 Inclusions: About 15 percent

Setting

Landforms: Kame moraines and pitted outwash plains
Position on the landform: Lida—summits and backslopes; Almora—footslopes and toeslopes; Dent—backslopes and footslopes
Slope range: Lida—1 to 8 percent; Almora—1 to 8 percent; Dent—1 to 6 percent

Component Description

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: Moderate

Almora

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 7.2 inches
Organic matter content: High

Dent

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.4 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Two Inlets and similar soils
- Bluffcreek and similar soils
- Lizzie and similar soils
- Oakcreek and similar soils
- Pinelake and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Lindaas Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderate; next part—slow; lower part—moderately slow

Landforms: Moraines, outwash plains, and lake terraces

Parent material: Glaciolacustrine deposits

Slope range: 0 to 2 percent

Taxonomic classification: Fine, montmorillonitic, frigid Typic Argiaquolls

Typical Pedon

Lindaas silty clay loam, morainic, 800 feet east and 1,000 feet north of the southwest corner of sec. 23, T. 135 N., R. 41 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate fine and medium subangular blocky structure; friable; common fine and medium roots; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; strong medium subangular blocky structure; friable; common fine and very fine roots; neutral; clear smooth boundary.

Bt—15 to 19 inches; very dark grayish brown (2.5Y

3/2) silty clay, dark gray (N 4/0) dry; moderate medium prismatic structure parting to strong fine and medium angular blocky; firm; common fine and very fine roots; common discontinuous distinct black (N 2/0) clay films on faces of peds; common fine distinct grayish brown (2.5Y 5/2) Fe depletions; neutral; clear wavy boundary.

Btg—19 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate medium prismatic structure parting to strong fine and medium angular blocky; firm; common fine and very fine roots; common discontinuous faint very dark grayish brown (2.5Y 3/2) clay films on faces of peds; common fine distinct gray (5Y 5/1) and common fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; common patchy distinct black (2.5Y 2/0) organic coatings on faces of peds; neutral; gradual irregular boundary.

Bkg—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam; weak fine and medium subangular blocky structure; firm; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; few patchy distinct very dark gray (N 3/0) organic coatings in root channels and pores; common fine irregular carbonate threads and few fine rounded soft masses of carbonates; violently effervescent; moderately alkaline; gradual wavy boundary.

Cg1—31 to 55 inches; olive gray (5Y 5/2) silty clay loam; weak medium subangular blocky soil fragments; firm; many fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; few fine irregular light gray (10YR 7/2) carbonate threads; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg2—55 to 60 inches; light olive gray (5Y 6/2) silt loam; weak medium plate-like soil fragments; friable; many fine and medium prominent strong brown (7.5YR 4/6) Fe concentrations; common fine irregular soft masses of iron-manganese; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 35 inches

Thickness of the mollic epipedon: 16 to 30 inches

A horizon:

Hue—10YR or 2.5Y

Value—2 or 3

Chroma—1 or 2

Texture—silty clay loam

Bt horizon:

Hue—10YR, 2.5Y, or 5Y

Value—3 to 5

Chroma—1 or 2
Texture—silty clay or clay

Bk horizon:

Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 to 3
Texture—silt loam or silty clay loam

Cg horizon:

Hue—2.5Y or 5Y
Value—5 to 7
Chroma—1 to 4
Texture—silt loam, clay loam, or silty clay loam

1129—Lindaas silty clay loam, morainic**Composition**

Lindaas and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landforms: Flats on outwash plains, lake terraces, and moraines
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bygland and similar soils
- Dent and similar soils
- Naytahwaush and similar soils
- Parnell and similar soils
- Soils that are underlain by outwash
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Lizzie Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderate or moderately rapid

Landforms: Moraines, lake terraces, and ice-walled lake plains

Parent material: Glaciolacustrine deposits

Slope range: 2 to 20 percent

Taxonomic classification: Fine-silty, mixed Boralfic Udic Argiborolls

Typical Pedon

Lizzie silt loam, 6 to 12 percent slopes, eroded (fig. 17), 2,300 feet south and 80 feet east of the northwest corner of sec. 12, T. 136 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—10 to 20 inches; brown (10YR 4/3) silt loam; moderate fine subangular blocky structure; friable; common fine roots; 50 percent or more dark grayish brown (10YR 4/2) sand coatings on faces of peds; few fine faint very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; slightly acid; gradual wavy boundary.

Bt2—20 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine and medium angular blocky structure; friable; common fine roots; few dark grayish brown (10YR 4/2) sand coatings on faces of peds; common fine faint dark brown (10YR 3/3) clay films on faces of peds and in pores; slightly acid; abrupt wavy boundary.

Bk—35 to 40 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine irregular light gray (10YR 7/2) carbonate threads; strongly effervescent; moderately alkaline; clear wavy boundary.

C—40 to 80 inches; yellowish brown (10YR 5/4) very fine sandy loam; massive; very friable; calcium carbonate disseminated throughout; slightly effervescent; slightly alkaline.



Figure 13.—Typical profile of Chapett loam. The subsoil has an accumulation of clay from a depth of 7 to 16 inches and an accumulation of lime below a depth of 16 inches. Depth is marked in feet.



Figure 14.—Typical profile of Eagleview loamy sand. Dark brown, discontinuous lamellae range from $\frac{1}{8}$ inch to 2 inches in thickness. Depth is marked in inches.



Figure 15.—Typical profile of Egeland fine sandy loam. This soil has a dark surface layer, a brown and light olive brown subsoil, and a sandy substratum. Depth is marked in feet.

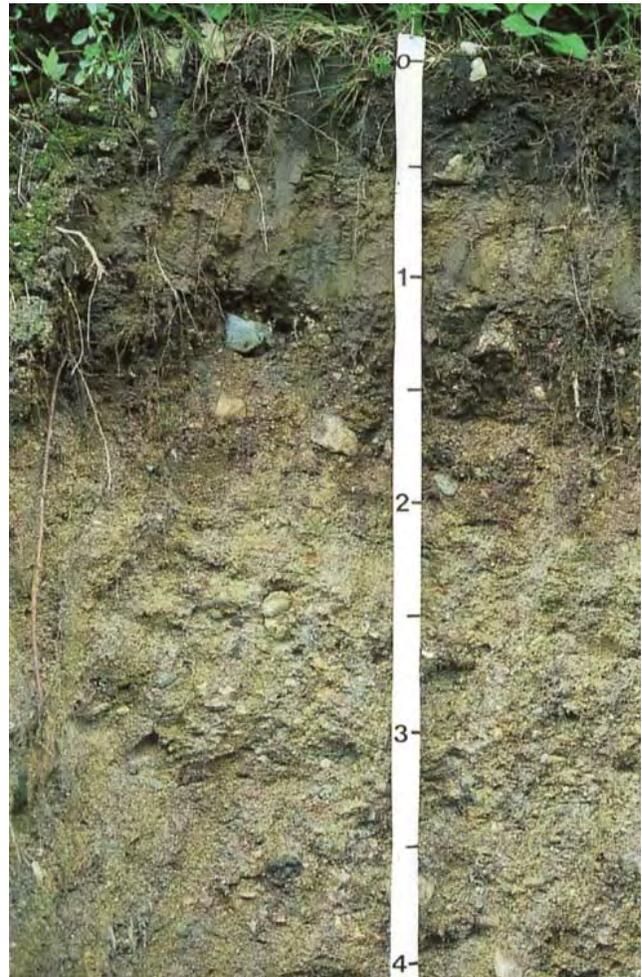


Figure 16.—Typical profile of Lida sandy loam. This soil has an accumulation of clay in the subsoil and has sand and gravel in the substratum. Depth is marked in feet.

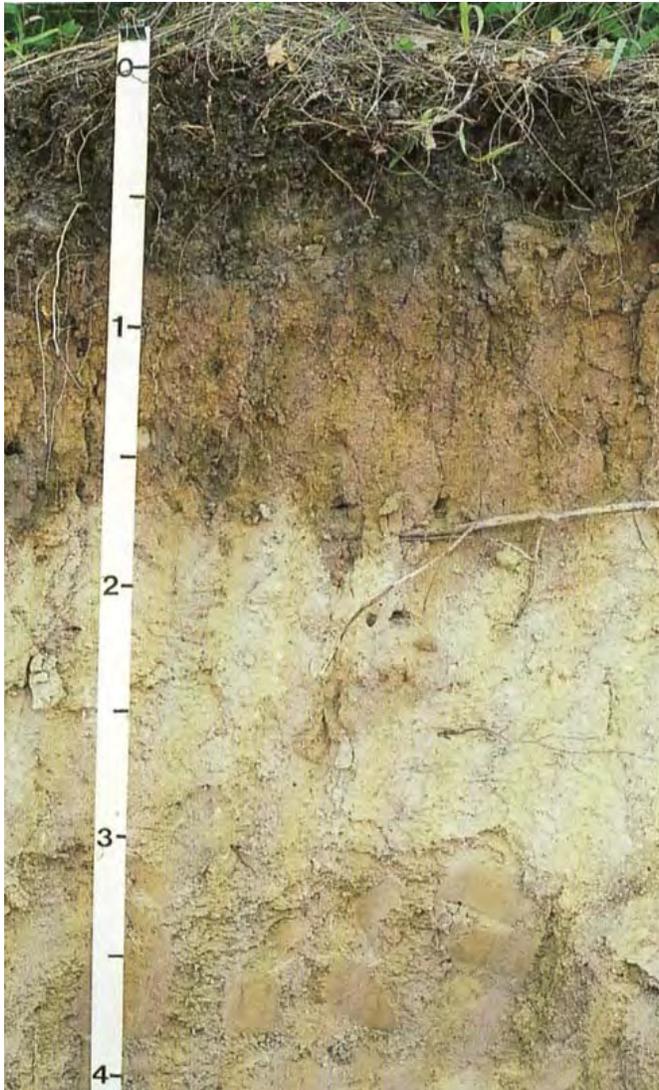


Figure 17.—Typical profile of Lizzie silt loam. The upper part of the subsoil has an accumulation of clay. Depth is marked in feet.



Figure 18.—Typical profile of Mahkonce clay loam. The upper part of the subsoil has an accumulation of clay. Depth is marked in feet.

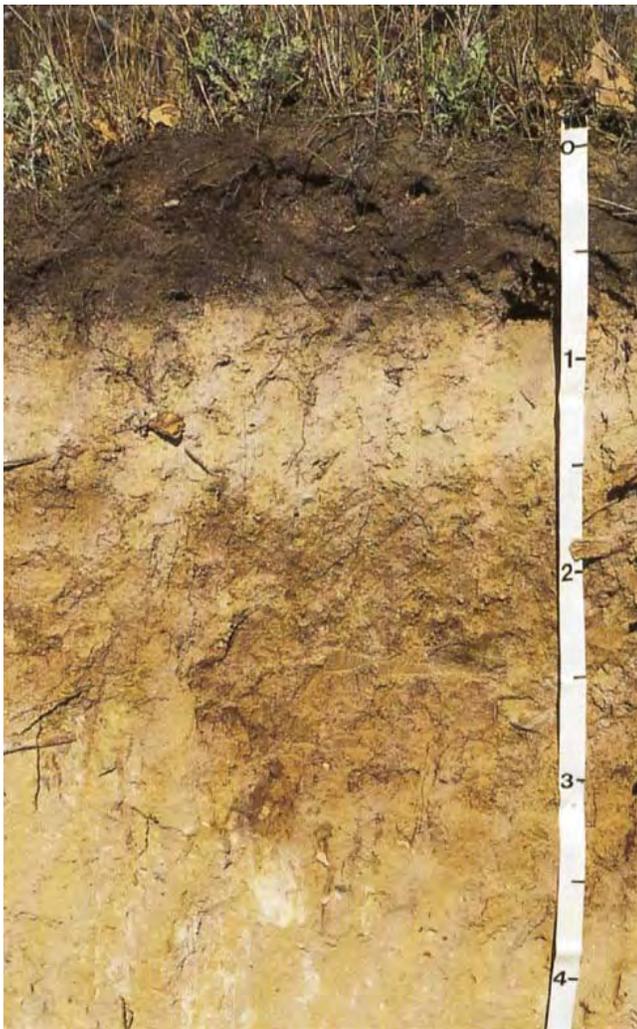


Figure 19.—Typical profile of Rockwood sandy loam. The light colored subsurface layer indicates the removal of clay. The subsoil has an accumulation of clay, and the substratum is dense till. Depth is marked in feet.

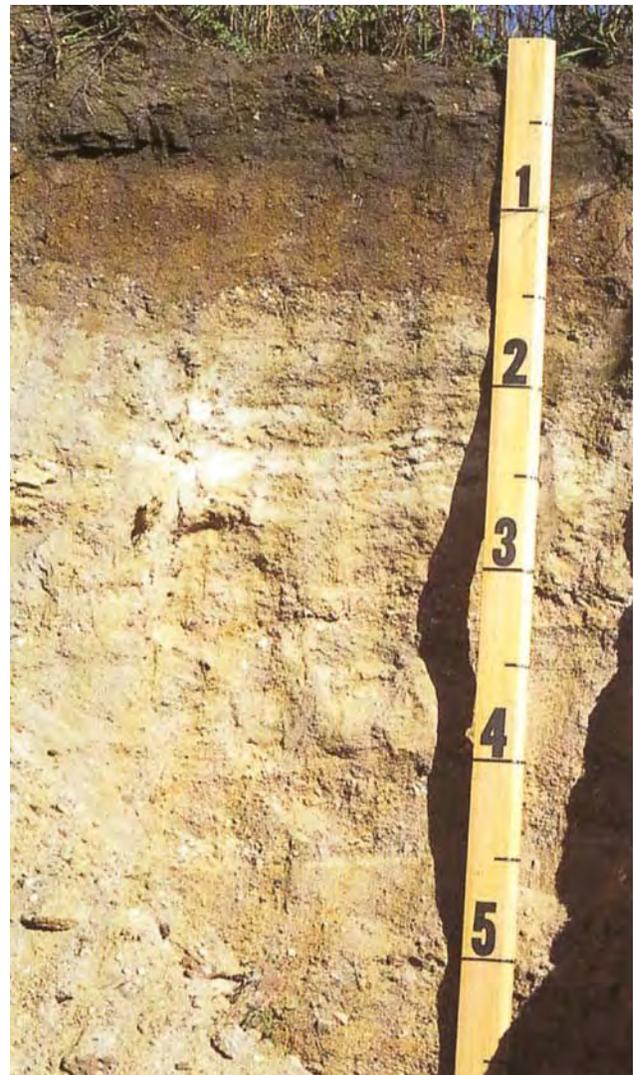


Figure 20.—Typical profile of Sandberg loamy sand. This soil has a thin mantle of loamy material over sandy and gravelly outwash. Depth is marked in feet.

Range in Characteristics

Depth to carbonates: 15 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches
Content of rock fragments: 0 to 2 percent throughout

Ap or A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1
 Texture—silt loam

Bt horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—2 to 4
 Texture—silty clay loam, silt loam, loam, or clay loam

Bk horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—3 or 4
 Texture—silt loam, loam, fine sandy loam, or very fine sandy loam

C horizon:

Hue—10YR or 2.5Y
 Value—5 or 6
 Chroma—3 to 6
 Texture—very fine sandy loam, silt loam, or loamy very fine sand with thin strata of fine sand below a depth of 40 inches

707B—Lizzie silt loam, 2 to 6 percent slopes

Composition

Lizzie and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landforms: Moraines, lake terraces, and ice-walled lake plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches



Figure 21.—Typical profile of Snellman sandy loam. The light colored subsurface layer indicates the removal of clay, and the subsoil has an accumulation of clay. Depth is marked in feet.

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils
- Dent and similar soils
- Lindaas and similar soils
- Quam and similar soils
- Almora and similar soils
- Bygland and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

707C2—Lizzie silt loam, 6 to 12 percent slopes, eroded**Composition**

Lizzie and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landforms: Moraines, lake terraces, and ice-walled lake plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.8 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils
- Dent and similar soils
- Lindaas and similar soils
- Quam and similar soils
- Almora and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

707D2—Lizzie silt loam, 12 to 20 percent slopes, eroded**Composition**

Lizzie and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landforms: Moraines, lake terraces, and ice-walled lake plains
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils
- Dent and similar soils
- Lindaas and similar soils
- Quam and similar soils
- Almora and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Mahkonce Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately slow;
next part—slow; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 1 to 4 percent

Taxonomic classification: Fine, montmorillonitic Aquic
Eutroboralfs

Typical Pedon

Mahkonce clay loam, 1 to 4 percent slopes (fig. 18), 2,300 feet west and 2,050 feet south of the northeast corner of sec. 2, T. 136 N., R. 42 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure; firm; many fine and medium roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

Bt—7 to 23 inches; olive brown (2.5Y 4/3) silty clay; moderate medium prismatic structure parting to strong fine and medium angular blocky; firm; common fine and medium roots; many discontinuous faint grayish brown (2.5Y 3/2) and common discontinuous distinct very dark brown (10YR 2/2) clay films on vertical and horizontal faces of peds; common fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations and few fine faint dark grayish brown (2.5Y 4/2) Fe depletions; neutral; gradual wavy boundary.

Btk—23 to 33 inches; olive brown (2.5Y 4/3) clay loam;

weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few very fine and fine roots; common discontinuous faint very dark grayish brown (2.5Y 3/2) clay films on vertical faces of peds; common medium faint grayish brown (2.5Y 5/2) Fe depletions; few rounded light gray (10YR 7/2) soft masses of carbonates; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bk—33 to 46 inches; grayish brown (2.5Y 5/2) clay loam; moderate medium and coarse subangular blocky structure; firm; many fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations; common discontinuous distinct very dark grayish brown (10YR 3/2) organic coatings in pores and root channels; common fine and medium irregular light gray (10YR 7/2) carbonate threads; common fine rounded light gray (10YR 7/2) soft masses of carbonates; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—46 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; many fine and medium distinct grayish brown (2.5Y 5/2) and common coarse prominent yellowish brown (10YR 5/6) Fe concentrations; few fine rounded soft masses of iron-manganese; common fine rounded light gray (10YR 7/2) soft masses of carbonates; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 40 inches

Content of rock fragments: 1 to 8 percent throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Bt horizon:

Hue—2.5Y or 10YR

Value—3 to 5

Chroma—2 to 4

Texture—clay loam, clay, silty clay, or silty clay loam

Bk horizon:

Hue—2.5Y or 10YR

Value—3 to 5

Chroma—2 to 4

Texture—loam, clay loam, or silty clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—2 to 4

Texture—loam, clay loam, or silty clay loam

1212B—Mahkonce clay loam, 1 to 4 percent slopes

Composition

Mahkonce and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Footslopes and toeslopes

Slope range: 1 to 4 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Cathro and similar soils
- Naytahwaush and similar soils
- Soils that are not underlain by till
- Areas that have stones on the surface
- Soils that are underlain by sandy loam till

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

McIntosh Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; lower part—moderately slow or moderate

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine-silty, frigid Aeric Calciaquolls

Typical Pedon

McIntosh silt loam, 1,300 feet south and 800 feet east of the northwest corner of sec. 33, T. 136 N., R. 45 W., in Wilkin County, Minnesota:

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—7 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; very friable; few fine rounded light gray (10YR 7/2) soft masses of carbonates; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk—12 to 25 inches; dark gray (10YR 4/1) silt loam; moderate medium subangular blocky structure; very friable; common medium rounded light gray (10YR 7/2) soft masses of carbonates; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg1—25 to 29 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; few fine prominent brownish yellow (10YR 6/8) and common fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 3 percent gravel; violently effervescent; slightly alkaline; gradual smooth boundary.

2Cg2—29 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; friable; few fine prominent yellowish red (5YR 5/6) and common fine and medium prominent yellowish brown (10YR 5/6 and 5/8) Fe concentrations; about 2 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 16 inches

Depth to glacial till: 24 to 40 inches

Ap or Ak horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—silt loam

Bk horizon:

Hue—10YR to 5Y
 Value—4 to 6
 Chroma—1 to 4
 Texture—silt loam, silty clay loam, or loam

2Cg horizon:

Hue—2.5Y
 Value—5 or 6
 Chroma—3 to 6
 Texture—clay loam or loam
 Content of rock fragments—2 to 10 percent

108—McIntosh silt loam**Composition**

McIntosh and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains
Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Winger and similar soils
- Hamerly and similar soils
- Soils in which carbonates have been leached to the subsoil
- Quam and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Meehan Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Upper part—moderately rapid; lower part—rapid
Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic classification: Mixed, frigid Aquic Udipsamments

Typical Pedon

Meehan loamy sand, 200 feet east and 2,550 feet north of the southwest corner of sec. 31, T. 135 N., R. 38 W.

- Ap—0 to 8 inches; very dark gray (10YR 3/1) loamy sand, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; common fine and medium roots; about 1 percent gravel; strongly acid; abrupt smooth boundary.
- Bw1—8 to 18 inches; brown (10YR 4/3) sand; weak medium subangular blocky structure; very friable; few very fine and fine roots; common dark brown (10YR 3/3) coatings on faces of peds; about 1 percent gravel; slightly acid; clear smooth boundary.
- Bw2—18 to 24 inches; brown (10YR 5/3) sand; single grain; loose; few very fine and fine roots; common medium faint dark grayish brown (10YR 4/2) and common medium distinct yellowish brown (10YR 5/6) Fe concentrations; about 2 percent gravel; slightly acid; clear smooth boundary.
- C—24 to 55 inches; dark yellowish brown (10YR 4/4) coarse sand; single grain; loose; few medium roots; common medium distinct dark grayish brown (10YR 4/2) and many coarse distinct yellowish brown (10YR 5/8) Fe concentrations; few dark reddish brown (5YR 3/2) manganese coatings on internal planes; about 2 percent gravel; slightly acid; gradual smooth boundary.
- Cg—55 to 60 inches; light brownish gray (10YR 6/2)

coarse sand; single grain; loose; common medium faint dark grayish brown (10YR 4/2) and many medium prominent yellowish brown (10YR 5/8) Fe concentrations; about 4 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

Content of rock fragments: 0 to 15 percent throughout

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy sand

Bw horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 to 8

Texture—sand, coarse sand, loamy sand, or loamy coarse sand

C or Cg horizon:

Hue—7.5YR or 10YR

Value—4 to 7

Chroma—2 to 4

Texture—sand or coarse sand

202—Meehan loamy sand

Composition

Meehan and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on pitted outwash plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 1.0 to 2.5 feet

Available water capacity to 60 inches or root-limiting layer: About 3.9 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hubbard and similar soils
- Clearriver and similar soils
- Leafriver and similar soils
- Roscommon and similar soils
- Bluffcreek and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Mehurin Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately slow; next part—slow or moderately slow; lower part—moderately slow or moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 4 percent

Taxonomic classification: Fine, montmorillonitic Aquertic Argiborolls

Typical Pedon

Mehurin clay loam, 1 to 4 percent slopes, 1,300 feet east and 225 feet north of the southwest corner of sec. 18, T. 131 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine granular; friable; common fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

A—9 to 13 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; common fine roots; about 2 percent gravel; slightly acid; gradual wavy boundary.

Bt1—13 to 21 inches; dark grayish brown (2.5Y 4/2) clay; moderate medium prismatic structure parting

to moderate fine subangular blocky; firm; common fine roots; many continuous distinct very dark gray (10YR 3/1) clay films on faces of peds; about 2 percent gravel; slightly acid; gradual wavy boundary.

Bt2—21 to 26 inches; grayish brown (2.5Y 5/2) clay loam; strong medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many discontinuous faint dark grayish brown (2.5Y 4/2) clay films on faces of peds; common medium distinct light olive brown (2.5Y 5/6) Fe concentrations; about 2 percent gravel; clear smooth boundary.

Bk—26 to 34 inches; light olive brown (2.5Y 5/4) clay loam; moderate fine subangular blocky structure; firm; common medium distinct grayish brown (2.5Y 5/2) Fe depletions; many fine irregular light gray (10YR 7/2) soft masses of carbonates; about 3 percent gravel; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—34 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; firm; many medium distinct light olive brown (2.5Y 5/6) Fe concentrations; few fine irregular light gray (10YR 7/2) soft masses of carbonates; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 14 to 36 inches

Thickness of the mollic epipedon: 8 to 16 inches

Content of rock fragments: 1 to 4 percent throughout

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—clay loam

Bt horizon:

Hue—2.5Y or 10YR

Value—3 to 5

Chroma—2 to 4

Texture—clay, silty clay, or clay loam

Bk horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—clay loam or loam

C horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—clay loam or loam

769B—Mehurin clay loam, 1 to 4 percent slopes

Composition

Mehurin and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 4 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Cathro and similar soils
- Peever and similar soils
- Soils that have carbonates in the surface soil
- Areas that have slopes of more than 4 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Mustinka Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately slow; next part—slow; lower part—moderately slow

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 1 percent

Taxonomic classification: Fine, montmorillonitic, frigid
Typic Argiaquolls

Typical Pedon

Mustinka silty clay loam, 300 feet west and 100 feet north of the southeast corner of sec. 2, T. 134 N., R. 47 W., in Wilkin County, Minnesota:

Ap—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and medium subangular blocky structure; firm; many fine roots; neutral; abrupt smooth boundary.

A—9 to 14 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and medium subangular blocky structure; firm; many fine roots; neutral; gradual wavy boundary.

Btg1—14 to 18 inches; dark olive gray (5Y 3/2) silty clay; moderate medium prismatic structure parting to moderate fine and medium angular blocky; firm; common fine roots; common discontinuous prominent black (N 2/0) clay films on faces of peds; neutral; clear wavy boundary.

Btg2—18 to 24 inches; olive gray (5Y 5/2) silty clay; moderate medium prismatic structure parting to moderate fine and medium angular blocky; firm; common fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; common fine roots; common discontinuous faint dark olive gray (5Y 3/2) clay films on faces of peds; neutral; gradual wavy boundary.

Bkg—24 to 36 inches; brownish gray (2.5Y 5/2) silty clay loam; moderate medium prismatic structure parting to moderate fine and medium angular blocky; firm; common fine distinct gray (5Y 6/1) Fe depletions and common fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; many fine soft masses of carbonate; common fine soft masses of iron-manganese; violently effervescent; moderately alkaline; gradual wavy boundary.

2Bkgy—36 to 52 inches; brownish gray (2.5Y 5/2) clay loam; moderate medium and coarse prismatic structure parting to weak fine and medium subangular blocky; firm; common fine distinct gray (5Y 6/1) Fe depletions and common fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; many fine soft masses of carbonate; common fine nests of gypsum; common fine soft iron-manganese masses; about 3 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2Cgy—52 to 80 inches; light olive brown (2.5Y 5/3)

clay loam; massive with few vertical geogenetic fractures 1 to 3 feet apart; firm; common fine faint light brownish gray (2.5Y 6/2) Fe depletions and common fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; common fine nests of gypsum; common fine soft iron-manganese masses; about 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 35 inches

Thickness of the mollic epipedon: 12 to 24 inches

Depth to glacial till: 20 to 50 inches

Content of rock fragments: Typically none in the upper part; 1 to 10 percent in the glacial till

A or Ap horizon:

Hue—10YR, 2.5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam

Btg horizon:

Hue—2.5Y, 5Y, or neutral

Value—3 to 5

Chroma—0 to 3

Texture—silty clay, clay, or silty clay loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 or 3

Texture—silty clay loam, silty clay, silt loam, or clay loam

2Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—clay loam, silty clay loam, or loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—clay loam, silty clay loam, or loam

1214—Mustinka silty clay loam

Composition

Mustinka and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on lake plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Seasonal high water table: At the surface to 1 foot below the surface

Available water capacity to 60 inches or root-limiting layer: About 10.2 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Hamerly and similar soils
- Haug and similar soils
- Soils that have carbonates in the surface soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Naytahwaush Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately slow or moderate; next part—slow; lower part—moderately slow

Landform: Moraines

Parent material: Till

Slope range: 4 to 30 percent

Taxonomic classification: Fine, montmorillonitic Mollic Eutroboralfs

Typical Pedon

Naytahwaush clay loam, 8 to 15 percent slopes, eroded, 1,800 feet east and 300 feet north of the southwest corner of sec. 12, T. 131 N., R. 38 W.

Ap—0 to 7 inches; black (10YR 2/1) clay loam, dark

gray (10YR 4/1) dry; strong medium subangular blocky structure; friable; many fine roots; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—7 to 12 inches; brown (10YR 4/3) clay; strong medium angular blocky structure; firm; many fine and very fine roots; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 1 percent gravel; slightly acid; clear wavy boundary.

Bt2—12 to 24 inches; brown (10YR 4/3) clay; strong medium subangular blocky structure; firm; common fine and very fine roots; common discontinuous faint dark brown (10YR 3/3) clay films on faces of peds; about 1 percent gravel; slightly acid; clear smooth boundary.

Bk—24 to 34 inches; light olive brown (2.5Y 5/3) clay loam; moderate medium subangular blocky structure; friable; common fine and very fine roots; few fine prominent dark yellowish brown (10YR 4/6) Fe concentrations; common discontinuous prominent very dark brown (10YR 2/2) organic coatings in root channels and in pores; common fine irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; violently effervescent; slightly alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/3) clay loam; massive; friable; few very fine roots; many fine faint olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4) Fe concentrations; few fine irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; slightly effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 21 to 40 inches

Content of rock fragments: 1 to 8 percent throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—clay loam

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—1 to 4

Texture—clay, silty clay, silty clay loam, or clay loam

Bk horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 to 5

Texture—clay loam, loam, or silty clay loam

C horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 to 5

Texture—clay loam, loam, or silty clay loam

718E—Naytahwaush loam, 15 to 30 percent slopes

Composition

Naytahwaush and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 15 to 30 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mahkonce and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Snellman and similar soils
- Areas that have slopes of more than 30 percent or less than 15 percent
- Soils that formed in outwash

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1208B—Naytahwaush-Mahkonce complex, 1 to 8 percent slopes

Composition

Naytahwaush and similar soils: About 45 percent
Mahkonce and similar soils: About 40 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Naytahwaush—footslopes and toeslopes; Mahkonce—summits and backslopes

Slope range: Naytahwaush—4 to 8 percent; Mahkonce—1 to 4 percent

Component Description

Naytahwaush

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches

Organic matter content: High

Mahkonce

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 8 percent
- Areas that have stones on the surface

- Soils that are underlain by sandy loam till

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1209C—Naytahwaush clay loam, 8 to 15 percent slopes, eroded

Composition

Naytahwaush and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 8 to 15 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.7 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Cathro and similar soils
- Mahkonce and similar soils
- Areas that have slopes of more than 15 percent or less than 8 percent
- Areas that have stones on the surface
- Soils that are underlain by sandy loam till

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Nidaros Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderately slow to moderately rapid; next part—moderate; lower part—rapid

Landforms: Pitted outwash plains and flood plains

Parent material: Organic materials over glacial outwash

Slope range: 0 to 1 percent

Taxonomic classification: Loamy, mixed, euic Terric Borosaprists

Typical Pedon

Nidaros muck, 275 feet east and 1,350 feet north of the southwest corner of sec. 15, T. 134 N., R. 38 W.

Oa1—0 to 20 inches; muck (sapric material), black (5YR 2/1) broken face, black (10YR 2/1) rubbed; about 6 percent fibers, 5 percent rubbed; strong medium granular structure; very friable; many fine and medium roots; fibers are primarily herbaceous; neutral; gradual smooth boundary.

Oa2—20 to 27 inches; muck (sapric material), black (N 2/0) broken face and rubbed; about 10 percent fibers, 2 percent rubbed; strong very thick platy structure; friable; fibers are primarily herbaceous; neutral; clear smooth boundary.

A1—27 to 33 inches; black (N 2/0) sandy clay loam; black (2.5Y 2/1) on faces of peds; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—33 to 38 inches; black (5Y 2/1) sandy loam; black (5Y 2/1) on faces of peds; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

2Cg—38 to 80 inches; olive gray (5Y 5/2) coarse sand single grain; loose; about 3 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 0 to more than 60 inches

Thickness of the histic epipedon: 16 to 50 inches

Oa horizon:

Hue—10YR, 7.5YR, 5YR, or neutral

Value—2 to 4

Chroma—0 to 3
Texture—muck

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—sandy clay loam, sandy loam, or loam or the mucky analogs of these textures

2Cg horizon:

Hue—2.5Y, 10YR, 7.5YR, 5Y, or neutral
Value—4 to 6
Chroma—0 to 4
Texture—coarse sand, sand, or loamy sand or the gravelly analogs of these textures
Content of rock fragments—0 to 35 percent gravel by volume

1111—Nidaros muck, frequently flooded

Composition

Nidaros and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on flood plains
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials over outwash
Frequency of flooding: Frequent
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 15.1 inches
Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hubbard and similar soils
- Duelm and similar soils
- Bluffcreek and similar soils

- Roscommon and similar soils
- Pinelake and similar soils

Major Uses of the Unit

- Forest land
For general and detailed information concerning these uses, see Part II of this publication:
- Forest Land section

1136—Nidaros muck

Composition

Nidaros and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic materials over outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 13.9 inches
Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hubbard and similar soils
- Dorset and similar soils
- Bluffcreek and similar soils
- Pinelake and similar soils
- Roscommon and similar soils
- Forada and similar soils

Major Uses of the Unit

- Hayland
- Pasture

- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1346—Nidaros muck, calcareous

Composition

Nidaros and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on pitted outwash plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over outwash

Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 14.0 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Dorset and similar soils
- Arveson and similar soils
- Pinelake and similar soils
- Haslie and similar soils

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Nitche Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid or moderate; next part—rapid; lower part—moderate

Landform: Moraines

Parent material: Glacial outwash over till

Slope range: 1 to 12 percent

Taxonomic classification: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Nitche sandy loam, in an area of Nitche-Kandota-Lida complex, 1 to 6 percent slopes, 2,425 feet east and 1,650 feet south of the northwest corner of sec. 24, T. 135 N., R. 40 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; friable; many very fine and fine roots; about 2 percent gravel; neutral; abrupt smooth boundary.

E—9 to 16 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; friable; common very fine and fine roots; about 2 percent gravel; slightly acid; clear smooth boundary.

Bt1—16 to 24 inches; dark brown (7.5YR 3/3) gravelly sandy loam; moderate medium subangular blocky structure; friable; many very fine and fine roots; about 30 percent gravel; common faint dark brown (7.5YR 3/2) clay films on faces of peds and in pores; few distinct (10YR 6/3) very fine sand and silt coatings on faces of peds; slightly acid; clear smooth boundary.

2Bt2—24 to 33 inches; brown (7.5YR 4/4) loamy sand; weak medium and coarse subangular blocky structure; very friable; few very fine and fine roots; about 10 percent gravel; common clay bridging between sand grains; neutral; clear smooth boundary.

2Bk1—33 to 55 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; common light gray (10YR 7/2) calcium carbonate coatings on the lower surfaces of pebbles; about 20 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

3Bk2—55 to 62 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; firm; few light gray (10YR 7/2) threads and masses of calcium carbonate; about 5 percent

gravel; slightly effervescent; moderately alkaline; clear smooth boundary.

3Bk3—62 to 70 inches; light olive brown (2.5Y 5/4) loam; moderate coarse subangular blocky structure; firm; many white (10YR 8/2) calcium carbonate coatings on vertical and horizontal faces of peds; few patchy yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) iron stains on faces of peds; about 5 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

3C—70 to 80 inches; light yellowish brown (2.5Y 6/4) sandy loam; massive parting to moderate medium and thick platy soil aggregates; friable; about 5 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches

Depth to glacial till: 40 to 60 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam, fine sandy loam, coarse sandy loam, or loam

Content of rock fragments—0 to 5 percent gravel

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 to 3

Texture—sandy loam, fine sandy loam, or loamy sand

Content of rock fragments—0 to 5 percent gravel

Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—dominantly sandy loam, fine sandy loam, coarse sandy loam, or loam or the gravelly analogs of these textures; subhorizons of sandy clay loam in some pedons

Content of rock fragments—0 to 35 percent gravel

2Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—loamy sand, loamy coarse sand, or the gravelly analogs of these textures

Content of rock fragments—0 to 35 percent gravel

2Bk horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 7

Chroma—2 to 6

Texture—loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures

Content of rock fragments—averages 10 to 35 percent

3Bk horizon:

Hue—10YR, 2.5Y, or 7.5YR

Value—4 to 6

Chroma—3 or 4

Texture—sand, coarse sand, loamy coarse sand, or loamy sand or the gravelly analogs of these textures

Content of rock fragments—0 to 25 percent gravel

3C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—3 to 6

Texture—sandy loam or fine sandy loam

Content of rock fragments—2 to 15 percent gravel by volume

705B—Nitche-Kandota-Lida complex, 1 to 6 percent slopes

Composition

Nitche and similar soils: About 40 percent

Kandota and similar soils: About 30 percent

Lida and similar soils: About 20 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 6 percent

Component Description

Nitche

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash over till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.9 inches

Organic matter content: High

Kandota

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.9 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Pinelake and similar soils
- Dorset and similar soils
- Two Inlets and similar soils
- Kratka and similar soils
- Oylen and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

705C—Nitche-Kandota-Lida complex, 6 to 12 percent slopes

Composition

Nitche and similar soils: About 35 percent
 Kandota and similar soils: About 30 percent
 Lida and similar soils: About 20 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Nitche

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 7.8 inches
Organic matter content: High

Kandota

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches
Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Pinelake and similar soils
- Dorset and similar soils
- Two Inlets and similar soils
- Kratka and similar soils
- Oylen and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Oakcreek Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate; next part—moderate or moderately rapid; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic classification: Fine-loamy, mixed Aquic Argiborolls

Typical Pedon

Oakcreek loam, 1,225 feet east and 875 feet south of the northwest corner of sec. 36, T. 131 N., R. 37 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; few and common very fine and fine roots; slightly acid; abrupt smooth boundary.

A—10 to 14 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; common very fine and fine roots; slightly acid; abrupt smooth boundary.

Bt1—14 to 23 inches; dark yellowish brown (10YR 4/4) loam; strong fine and medium subangular blocky structure; firm; common discontinuous distinct dark brown (10YR 3/3) clay films on faces of peds and in pores; common continuous distinct white (10YR 8/2) very fine sand and silt coatings on faces of peds; few fine and medium roots; slightly acid; clear smooth boundary.

Bt2—23 to 28 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium and coarse subangular blocky structure; firm; many fine and medium prominent grayish brown (2.5Y 5/2) Fe depletions and common fine and medium distinct brown (7.5YR 4/4) and common fine prominent reddish brown (5YR 4/4) Fe concentrations; common discontinuous distinct dark brown (7.5YR 3/3) clay films on faces of peds and in pores;

about 3 percent gravel; few fine and medium roots; neutral; clear smooth boundary.

Bt3—28 to 33 inches; dark brown (10YR 3/3) coarse sandy loam; moderate medium subangular blocky structure; friable; common medium and coarse faint dark brown (7.5YR 4/3) Fe concentrations; common discontinuous faint very dark grayish brown (10YR 3/2) clay films and organic coatings on faces of peds; about 7 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Btk1—33 to 38 inches; brown (10YR 4/3) gravelly coarse sandy loam; moderate medium subangular blocky structure; friable; common medium and coarse faint dark grayish brown (10YR 4/2) Fe depletions; common discontinuous faint very dark gray (10YR 3/1) and dark gray (10YR 4/1) clay films and organic coatings on faces of peds; common very pale brown (10YR 7/3) calcium carbonate masses and coatings on faces of peds; about 30 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2Btk2—38 to 47 inches; brown (10YR 4/3) gravelly loamy coarse sand; weak coarse subangular blocky structure; very friable; common medium and coarse faint dark grayish brown (10YR 4/2) Fe depletions; common patchy faint very dark gray (10YR 3/1) clay bridging and organic coatings on and between sand grains; common very pale brown (10YR 7/3) calcium carbonate masses; about 30 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2C—47 to 80 inches; light yellowish brown (2.5Y 6/3) gravelly coarse sand; single grain; loose; many coarse faint light brownish gray (2.5Y 6/2) Fe depletions; about 18 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 24 to 40 inches

Content of rock fragments: 0 to 10 percent in the loamy mantle and 10 to 35 percent in the lower part of the profile

A or Ap horizon:

Hue—10YR or 7.5YR

Value—2 or 3

Chroma—1 to 3

Texture—loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—loam, fine sandy loam, or sandy loam

Bt horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 to 6

Texture—dominantly loam, silt loam, or sandy clay loam; subhorizons of sandy loam, coarse sandy loam, or fine sandy loam or the gravelly analogs of these textures in some pedons

2Bt or 2Btk horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—3 or 4

Texture—sand, loamy coarse sand, or loamy sand or the gravelly analogs of these textures

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 4

Texture—dominantly coarse sand, sand, or the gravelly analogs of these textures; subhorizons of fine sand, loamy coarse sand, loamy sand, or loamy fine sand or the gravelly analogs of these textures in some pedons

1338—Oakcreek loam

Composition

Oakcreek and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 7.5 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Leafriver and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Oylen Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid or moderate; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 3 percent

Taxonomic classification: Coarse-loamy, mixed Aquic Argiborolls

Typical Pedon

Oylen sandy loam, 1,025 feet north and 4,750 feet east of the southwest corner of sec. 4, T. 134 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common very fine and fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

AB—9 to 13 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; moderate medium subangular blocky structure; friable; few very fine and fine roots; few patchy faint very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; about 1 percent gravel; neutral; abrupt smooth boundary.

Bt1—13 to 18 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium and coarse subangular blocky structure; friable; many discontinuous faint brown (10YR 4/3) clay films on faces of peds and in pores; about 1 percent gravel; neutral; clear smooth boundary.

Bt2—18 to 22 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; weak medium subangular blocky structure; friable; many discontinuous faint brown (10YR 4/3) clay films on faces of peds and in pores; about 13 percent gravel; neutral; clear wavy boundary.

2Bw—22 to 26 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; about 20 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2Bk—26 to 35 inches; light yellowish brown (2.5Y 6/4) gravelly coarse sand; single grain; loose; few prominent patchy very pale brown (10YR 8/3) carbonate coatings on the lower surfaces of pebbles; about 34 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

2C—35 to 60 inches; very pale brown (10YR 7/3) gravelly coarse sand; single grain; loose; many coarse distinct light brownish gray (2.5Y 6/2) Fe depletions and common fine and medium distinct brownish yellow (10YR 6/8) Fe concentrations; about 20 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 60 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 0 to 5 percent in the upper sediments and 0 to 25 percent in the lower sediments

Thickness of the loamy mantle: 15 to 24 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

Bt horizon:

Hue—10YR or 7.5YR

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam or loam

2Bw horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—sand, coarse sand, or very coarse sand or the gravelly analogs of these textures

1975—Oylen sandy loam

Composition

Oylen and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 5.1 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dorset and similar soils
- Duelm and similar soils
- Clitherall and similar soils
- Pinelake and similar soils
- Nidaros and similar soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Paddock Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow

Landform: Drumlins

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed, frigid Udollic Epiaqualfs

Typical Pedon

Paddock fine sandy loam, in an area of Paddock-Becida complex, stony, 175 feet west and 2,125 feet south of the northeast corner of sec. 28, T. 137 N., R. 36 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine and medium roots; about 2 percent gravel; moderately acid; abrupt smooth boundary.

E/B—8 to 15 inches; sandy loam, about 90 percent brown (10YR 5/3) (E) and 10 percent dark yellowish brown (10YR 4/4) (B); weak medium subangular blocky structure; friable; few very fine roots; common medium distinct grayish brown (2.5Y 5/2) Fe depletions and common prominent strong brown (7.5YR 5/6) Fe concentrations; about 2 percent gravel; moderately acid; clear smooth boundary.

Bt1—15 to 21 inches; grayish brown (2.5Y 5/2) sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; common discontinuous distinct grayish brown (10YR 5/2) clay films on faces of peds and in pores; common medium prominent strong brown (7.5YR 5/8) and common prominent yellowish brown (10YR 5/8) Fe concentrations; about 2 percent gravel; moderately acid; clear smooth boundary.

Bt2—21 to 28 inches; brown (10YR 4/3) sandy loam; weak fine subangular blocky structure; friable; few very fine roots; few patchy faint grayish brown (10YR 5/2) clay films between sand grains; common medium distinct grayish brown (2.5Y 5/2) Fe depletions and common coarse prominent yellowish red (5YR 5/6) Fe concentrations; about 2 percent gravel; moderately acid; clear smooth boundary.

Bt3—28 to 36 inches; dark yellowish brown (10YR 4/4)

sandy loam; moderate medium subangular blocky structure; firm; few very fine roots; few patchy prominent dark reddish brown (5YR 3/2) clay films in root channels and pores; common coarse prominent grayish brown (2.5Y 5/2) Fe depletions and common medium prominent strong brown (7.5YR 5/8) Fe concentrations; about 3 percent gravel; moderately acid; clear wavy boundary.

BC—36 to 40 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; firm; few patchy prominent dark brown (7.5YR 3/2) clay films in root channels and pores; about 3 percent gravel; slightly acid; clear wavy boundary.

Cd—40 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; massive with moderate thin platy soil fragments; very firm; about 3 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 40 to 55 inches

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 15 percent gravel; 0 to 3 percent cobbles

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or fine sandy loam

EB, E/B, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—dominantly sandy loam; subhorizons of loam, fine sandy loam, or sandy clay loam in some pedons

Cd horizon:

Hue—2.5Y or 10YR

Value—4 to 6

Chroma—3 to 6

Texture—dominantly sandy loam; subhorizons of loamy sand in some pedons

1321—Paddock-Becida complex, stony**Composition**

Paddock and similar soils: About 55 percent

Becida and similar soils: About 30 percent

Inclusions: About 15 percent

Setting

Landform: Drumlins

Position on the landform: Paddock—footslopes and toeslopes; Becida—toeslopes

Slope range: 0 to 2 percent

Component Description**Paddock**

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 1 to 2 feet

Available water capacity to 60 inches or root-limiting layer: About 6.1 inches

Organic matter content: High

Becida

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: At the surface to 1 foot below the surface

Available water capacity to 60 inches or root-limiting layer: About 5.7 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cathro and similar soils
- Runeberg and similar soils
- Rockwood and similar soils
- Blowers and similar soils
- Soils that have outwash over till

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Parnell Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderately slow or moderate; next part—slow; lower part—slow or moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 3 percent

Taxonomic classification: Fine, montmorillonitic, frigid Vertic Argiaquolls

Typical Pedon

Parnell silty clay loam, depressional, 2,200 feet west and 1,880 feet north of the southeast corner of sec. 25, T. 133 N., R. 42 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—9 to 18 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; firm; common fine roots; neutral; clear smooth boundary.

Btg1—18 to 32 inches; very dark gray (5Y 3/1) silty clay, dark gray (5Y 4/1) dry; weak medium prismatic structure parting to moderate fine subangular blocky; firm; common fine roots; few discontinuous prominent black (10YR 2/1) clay films on faces of peds; slightly acid; clear smooth boundary.

Btg2—32 to 42 inches; very dark gray (5Y 3/1) silty clay; weak medium prismatic structure parting to strong fine subangular blocky; firm; few fine roots; few discontinuous prominent black (10YR 2/1) clay films on faces of peds; few fine prominent light olive brown (2.5Y 5/4) Fe concentrations; neutral; gradual smooth boundary.

Btg3—42 to 50 inches; olive gray (5Y 4/2) silty clay; weak medium prismatic structure parting to strong fine subangular blocky; firm; few fine roots; few discontinuous prominent black (10YR 2/1) clay

films on faces of peds; few fine prominent light olive brown (2.5Y 5/4) Fe concentrations; neutral; gradual wavy boundary.

Cg—50 to 60 inches; olive gray (5Y 5/2) silty clay loam; massive; firm; common medium distinct olive (5Y 5/4) Fe concentrations; about 1 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 35 to more than 60 inches

Thickness of the mollic epipedon: 24 to 60 inches

Content of rock fragments: 0 to 8 percent throughout

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—silty clay loam

Btg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—2 to 4

Chroma—1 or 2

Texture—silty clay, silty clay loam, clay loam, or clay

C horizon:

Hue—10YR, 2.5Y, or 5Y

Value—3 to 6

Chroma—1 or 2

Texture—silty clay loam, silty clay, clay loam, clay, or loam

34—Parnell silty clay loam, depressional

Composition

Parnell and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 10.2 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Soils that have a silty surface layer
- Soils in which carbonates are closer to the surface than in the Parnell soil
- Poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

680—Parnell silt loam

Composition

Parnell and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.3 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Aazdahl and similar soils
- Hamerly and similar soils
- Gonvick and similar soils
- Roliss and similar soils
- Mehurin and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Peever Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately slow; lower part—slow or moderately slow

Landform: Moraines

Parent material: Till

Slope range: 3 to 18 percent

Taxonomic classification: Fine, montmorillonitic Udic Argiborolls

Typical Pedon

Peever clay loam, 6 to 12 percent slopes, 1,260 feet east and 2,150 feet south of the northwest corner of sec. 13, T. 131 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine roots; about 1 percent gravel; neutral; abrupt smooth boundary.

Bt1—9 to 13 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong medium subangular blocky structure; firm; many fine roots; many discontinuous distinct black (10YR 2/1) clay films on faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

Bt2—13 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many fine roots; common discontinuous distinct very dark gray (10YR 3/1) clay films on faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

Bk1—18 to 24 inches; dark grayish brown (2.5Y 4/2)

clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; many fine roots; common fine distinct gray (10YR 5/1) relict Fe depletions and common fine distinct brown (10YR 5/3) relict Fe concentrations; about 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—24 to 37 inches; olive brown (2.5Y 4/4) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common medium prominent yellowish brown (10YR 5/6) and common fine distinct brown (10YR 5/3) relict Fe concentrations and many fine prominent gray (10YR 5/1) relict Fe depletions; about 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) clay loam; massive; firm; few fine prominent reddish brown (5YR 4/4) and common fine distinct yellowish brown (10YR 5/4) relict Fe concentrations and many fine prominent gray (10YR 5/1) relict Fe depletions; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 13 to 26 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: 1 to 6 percent throughout

A horizon:

Hue—10YR
Value—2 or 3
Chroma—1
Texture—clay loam

Bt horizon:

Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1 to 3
Texture—clay, silty clay, or clay loam

Bk and C horizons:

Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—clay loam

646C—Peever clay loam, 6 to 12 percent slopes

Composition

Peever and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mehurin and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Soils that have carbonates above the subsoil
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

646D—Peever clay loam, 12 to 18 percent slopes**Composition**

Peever and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 12 to 18 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mehurin and similar soils
- Parnell and similar soils
- Cathro and similar soils
- Soils that have carbonates above the subsoil
- Areas that have slopes of more than 18 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

779B—Peever-Mehurin complex, 2 to 6 percent slopes**Composition**

Peever and similar soils: About 45 percent

Mehurin and similar soils: About 40 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Peever—summits and backslopes; Mehurin—footslopes and toeslopes

Slope range: Peever—3 to 6 percent; Mehurin—2 to 4 percent

Component Description

Peever

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches
Organic matter content: High

Mehurin

Texture of the surface layer: Clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Calcareous, poorly drained soils
- Cathro and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Pinelake Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid in the upper part, rapid in the lower part; loamy substratum phase—

moderately rapid in the upper part, rapid in the next part, moderate in the lower part

Landforms: Pitted outwash plains and moraines

Parent material: Glacial outwash and glacial outwash over till

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed, frigid Typic Argiaquolls

Typical Pedon

Pinelake sandy loam, 1,900 feet west and 300 feet north of the southeast corner of sec. 15, T. 134 N., R. 40 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few fine and medium roots throughout; 2 percent gravel; neutral; abrupt smooth boundary.

Btg1—12 to 15 inches; grayish brown (2.5Y 5/2) coarse sandy loam; weak fine and medium subangular blocky structure; friable; common fine prominent strong brown (7.5YR 4/6) Fe concentrations; few very fine and fine roots throughout; few distinct olive gray (5Y 4/2) clay films on faces of peds; 2 percent gravel; neutral; clear smooth boundary.

Btg2—15 to 30 inches; dark grayish brown (2.5Y 4/2) coarse sandy loam; moderate fine and medium subangular blocky structure; friable; common fine faint dark yellowish brown (2.5Y 6/2) Fe depletions and few fine prominent light olive brown (2.5Y 5/6) Fe concentrations; common distinct dark olive gray (5Y 3/2) discontinuous clay films on faces of peds; 2 percent gravel; neutral; clear wavy boundary.

2Btg3—30 to 35 inches; grayish brown (2.5Y 5/2) loamy coarse sand; weak medium subangular blocky structure; very friable; many medium prominent yellowish brown (10YR 5/6) Fe concentrations; common distinct olive gray (5Y 4/2) clay bridging between sand grains; 2 percent gravel; neutral; clear wavy boundary.

2Cg—35 to 80 inches; light brownish gray (2.5Y 6/2) coarse sand; single grain; loose; common medium and coarse brownish yellow (10YR 6/6) Fe concentrations; 6 percent gravel; very slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches

Thickness of the mollic epipedon: 7 to 20 inches

Thickness of the loamy mantle: 20 to 40 inches

A or Ap horizon:

Hue—10YR, 2.5Y, or neutral
 Value—2 or 3
 Chroma—0 to 2
 Texture—sandy loam
 Content of rock fragments—0 to 15 percent

Btg horizon:

Hue—10YR, 5Y, or 2.5Y
 Value—3 to 5
 Chroma—1 to 3
 Texture—coarse sandy loam, sandy loam, or loam
 Content of rock fragments—0 to 35 percent

2Btg horizon:

Hue—10YR, 2.5Y, or 5Y
 Value—4 or 5
 Chroma—1 to 3
 Texture—loamy sand, loamy coarse sand, or sand
 or the gravelly analogs of these textures
 Content of rock fragments—0 to 35 percent

2Cg horizon:

Hue—2.5Y or 5Y
 Value—5 to 7
 Chroma—1 or 2
 Texture—loamy sand, loamy coarse sand, sand,
 or coarse sand or the gravelly analogs of these
 textures
 Content of rock fragments—0 to 35 percent

3Cg horizon (if it occurs):

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—dominantly sandy loam, fine sandy loam,
 or loam; subhorizons of clay loam or sandy clay
 loam in some pedons
 Content of rock fragments—3 to 15 percent

1215—Pinelake sandy loam

Composition

Pinelake and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

*Available water capacity to 60 inches or root-limiting
 layer:* About 5.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Leafriver and similar soils
- Nidaros and similar soils
- Dorset and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

**1342—Pinelake, loamy substratum-
 Brandsvold complex**

Composition

Pinelake and similar soils: About 60 percent
 Brandsvold and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and swales on moraines
Slope range: 0 to 2 percent

Component Description

Pinelake

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
*Available water capacity to 60 inches or root-limiting
 layer:* About 6.2 inches

Organic matter content: High

Brandsvold

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Wykeham and similar soils
- Cathro and similar soils
- Kratka and similar soils
- Clitherall and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1030—Pits, gravel-Udipsamments complex

Composition

Pits: 50 percent

Udipsamments: 45 percent

Inclusions: About 5 percent

Component Description

Pits

Dominant parent material: Glacial outwash

Udipsamments

Texture of the surface layer: Sand

Depth class: Very deep (more than 60 inches)

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Very low

Inclusions

- Poorly drained soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

Quam Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Upper part—moderate; lower part—moderately slow

Landform: Moraines

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 1 percent

Taxonomic classification: Fine-silty, mixed, frigid Cumulic Endoaquolls

Typical Pedon

Quam silt loam, 2,300 feet north and 1,700 feet east of the southwest corner of sec. 23, T. 134 N., R. 44 W.

Ap—0 to 9 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A1—9 to 27 inches; black (N 2/0) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium platy; friable; common fine roots; few fine prominent olive brown (2.5Y 4/4) Fe concentrations; neutral; clear smooth boundary.

A2—27 to 47 inches; black (N 2/0) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; firm; few fine roots; few fine prominent olive brown (2.5Y 4/4) Fe concentrations; neutral; clear wavy boundary.

A3—47 to 56 inches; black (5Y 2.5/1) silty clay loam, dark gray (5Y 4/1) dry; weak medium subangular blocky structure; firm; neutral; clear wavy boundary.

2Cg1—56 to 60 inches; dark gray (5Y 4/1) loam;

massive; friable; few fine prominent light olive brown (2.5Y 5/6) Fe concentrations; many discontinuous faint very dark gray (5Y 3/1) organic coatings on faces of peds; about 2 percent gravel; neutral; clear wavy boundary.

2Cg2—60 to 80 inches; gray (5Y 5/1) loam; many medium prominent yellowish brown (10YR 5/6) Fe concentrations; massive; friable; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 60 inches

Thickness of the mollic epipedon: 24 to 60 inches

Depth to glacial till: 24 to 60 inches

Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silt loam

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silt loam, silty clay loam, silty clay, or loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—loam, silt loam, silty clay loam, or clay loam

Content of rock fragments—2 to 8 percent

1227—Quam, Cathro, and Urness soils, ponded

Composition

Quam: Variable

Cathro: Variable

Urness: Variable

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Quam

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 12.5 inches

Organic matter content: Very high

Cathro

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials over glaciolacustrine deposits or till

Flooding: None

Seasonal high water table: 4.0 feet above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 16.7 inches

Organic matter content: Very high

Urness

Texture of the surface layer: Mucky silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Coprogenous earth

Flooding: None

Seasonal high water table: At the surface to 3 feet above the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.5 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Lakepark and similar soils
- Roliss and similar soils
- Vallery and similar soils
- Haslie and similar soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

1239—Quam silt loam

Composition

Quam and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Swales on moraines
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches
Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lakepark and similar soils
- Roliss and similar soils
- Cathro and similar soils
- Darnen and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Radium Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid or very rapid
Landform: Pitted outwash plains
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic classification: Sandy, mixed Aquic Haploborolls

Typical Pedon

Radium loamy sand, 820 feet east and 500 feet north of the southwest corner of sec. 16, T. 131 N., R. 44 W.

- Ap—0 to 11 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; common fine and very fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.
- Bw—11 to 18 inches; brown (10YR 4/3) loamy sand; weak very fine subangular blocky structure; very friable; common fine and very fine roots; about 5 percent gravel; neutral; clear smooth boundary.
- Bk1—18 to 24 inches; yellowish brown (10YR 5/4) very gravelly coarse sand; single grain; loose; few very fine roots; many discontinuous distinct light gray (10YR 7/2) carbonate coatings on the underside of pebbles; many rounded light gray (10YR 7/2) soft masses of carbonates; about 40 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.
- Bk2—24 to 30 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; common fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations; many discontinuous distinct light gray (10YR 7/2) carbonate coatings on the underside of pebbles; many fine rounded light gray (10YR 7/2) soft masses of carbonates; about 25 percent gravel; strongly effervescent; moderately alkaline; gradual smooth boundary.
- C—30 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; common fine and medium prominent yellowish brown (10YR 5/6) Fe concentrations; common fine rounded light gray (10YR 7/2) soft masses of carbonates; about 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 10 to 30 inches
Thickness of the mollic epipedon: 10 to 20 inches

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—loamy sand
 Content of rock fragments—0 to 5 percent

Bw horizon:

Hue—10YR
 Value—2 to 4
 Chroma—1 to 3
 Texture—loamy sand, loamy fine sand, sand,
 gravelly loamy coarse sand, or gravelly sand
 Content of rock fragments—5 to 35 percent

Bk horizon:

Hue—10YR or 2.5Y
 Value—4 or 5
 Chroma—2 to 4
 Texture—dominantly sand, loamy sand, coarse
 sand, or loamy coarse sand or the gravelly
 analogs of these textures; subhorizons of the
 very gravelly analogs of these textures in some
 pedons

C horizon:

Hue—10YR or 2.5Y
 Value—4 to 7
 Chroma—2 to 4
 Texture—sand, loamy sand, coarse sand, or
 loamy coarse sand or the gravelly analogs of
 these textures
 Content of rock fragments—5 to 35 percent

1874—Radium loamy sand**Composition**

Radium and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on pitted outwash
 plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
*Available water capacity to 60 inches or root-limiting
 layer:* About 3.7 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Sandberg and similar soils
- Arvilla and similar soils
- Forada and similar soils
- Leafriver and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Rifle Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderate or moderately rapid

Landforms: Outwash plains and moraines

Parent material: Organic materials

Slope range: 0 to 1 percent

Taxonomic classification: Euic Typic Borohemists

Typical Pedon

Rifle mucky peat, 75 feet west and 50 feet south of the northeast corner of sec. 24, T. 135 N., R. 38 W.

Oe1—0 to 21 inches; mucky peat (hemic material), dark brown (7.5YR 3/2) broken face; about 75 percent herbaceous fibers, 70 percent rubbed; weak coarse subangular blocky structure; very friable; moderately acid; clear smooth boundary.

Oe2—21 to 80 inches; mucky peat (hemic material), very dark brown (10YR 2/2) broken face; about 90 percent herbaceous fibers, 35 percent rubbed; weak medium platy structure; moderately acid.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

Thickness of the histic epipedon: Greater than 51 inches

Oe1 horizon:

Hue—10YR to 5YR
 Value—2 or 3
 Chroma—1 to 4
 Texture—mucky peat

Oe2 horizon:

Hue—10YR, 7.5YR, or 5YR

Value—2 to 4

Chroma—2 to 4

Texture—dominantly mucky peat; muck or peat layers with a combined thickness of up to 10 inches are included in the range

541—Rifle mucky peat**Composition**

Rifle and similar soils: About 95 percent

Inclusions: About 5 percent

Setting*Landforms:* Depressions on moraines and outwash plains*Slope range:* 0 to 1 percent**Component Description***Texture of the surface layer:* Mucky peat*Depth class:* Very deep (more than 60 inches)*Drainage class:* Very poorly drained*Dominant parent material:* Organic materials*Flooding:* None*Seasonal high water table:* 1 foot above to 1 foot below the surface*Ponding duration:* Very long*Available water capacity to 60 inches or root-limiting layer:* About 31.8 inches*Organic matter content:* Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Epoufette and similar soils
- Egglake and similar soils
- Bluffton and similar soils
- Runeberg and similar soils
- Bluffcreek and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rockwell Series*Depth class:* Very deep*Drainage class:* Poorly drained*Permeability:* Upper part—moderate or moderately rapid; next part—rapid; lower part—moderately slow or moderate*Landform:* Lake plains*Parent material:* Glaciolacustrine deposits over till*Slope range:* 0 to 1 percent*Taxonomic classification:* Coarse-loamy, frigid Typic Calciaquolls**Typical Pedon**

Rockwell loam, 2,400 feet south and 2,200 feet west of the northeast corner of sec. 5, T. 132 N., R. 44 W.

Ap—0 to 10 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; few very fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ak—10 to 14 inches; black (5Y 2.5/1) fine sandy loam, gray (5Y 5/1) dry; weak fine granular structure; friable; few very fine roots; common fine irregular light gray (10YR 7/2) carbonate threads; violently effervescent; moderately alkaline; clear wavy boundary.

Bkg—14 to 27 inches; gray (5Y 5/1) fine sandy loam; weak fine subangular blocky structure; friable; few very fine roots; common fine irregular light gray (10YR 7/2) carbonate threads; violently effervescent; moderately alkaline; clear wavy boundary.

2Cg1—27 to 36 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; massive; very friable; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; about 2 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

3Cg2—36 to 60 inches; grayish brown (2.5Y 5/2) loam; massive; friable; common medium prominent yellowish brown (10YR 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) carbonate threads; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics*Carbonates:* At or near the surface*Thickness of the mollic epipedon:* 7 to 18 inches*Depth to glacial till:* 20 to 40 inches*A or Ak horizon:*

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—loam

Bkg horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam

2Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—sand, fine sand, loamy sand, or loamy fine sand

3Cg horizon:

Hue—2.5Y or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—loam, silt loam, clay loam, or silty clay loam

Content of rock fragments—2 to 8 percent

63—Rockwell loam

Composition

Rockwell and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and swales on lake plains

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arveson and similar soils
- Hamerly and similar soils

- Soils in which carbonates have been leached
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Rockwood Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; next part—moderately slow; lower part—very slow

Landform: Drumlins

Parent material: Till

Slope range: 2 to 20 percent

Taxonomic classification: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Rockwood sandy loam, 6 to 12 percent slopes, stony (fig. 19), 725 feet west and 750 feet north of the southeast corner of sec. 23, T. 137 N., R. 36 W.

- A—0 to 9 inches; very dark gray (10YR 3/1) sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; common fine and medium roots; about 5 percent gravel; strongly acid; abrupt smooth boundary.
- E—9 to 16 inches; brown (10YR 5/3) loamy sand, light gray (10YR 7/2) dry; weak medium subangular blocky structure; very friable; few very fine roots; about 5 percent gravel; moderately acid; clear smooth boundary.
- E/B—16 to 27 inches; about 15 percent brown (10YR 5/3) loamy sand (E), 85 percent dark brown (10YR 4/3) sandy loam (Bt); weak medium subangular blocky structure; friable; many continuous light brownish gray (10YR 6/2) sand coatings on faces of ped; few very fine roots; about 12 percent gravel; moderately acid; clear smooth boundary.
- Bt—27 to 37 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; firm; few discontinuous faint brown (10YR 4/3) clay films on faces of ped; about 5 percent gravel; slightly acid; clear smooth boundary.
- BC—37 to 41 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium subangular blocky

structure; firm; about 2 percent gravel; neutral; clear wavy boundary.

Cd—41 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; weak thick platy soil fragments; firm; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 40 to 60 inches

Depth to dense till: 40 to 60 inches

Content of rock fragments: 2 to 15 percent gravel; 0 to 3 percent cobbles

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam or loamy sand

EB, E/B, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 or 4

Texture—dominantly sandy loam; subhorizons of sandy clay loam in some pedons

Cd horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—dominantly sandy loam; subhorizons of loamy sand in some pedons

1319B—Rockwood sandy loam, 2 to 6 percent slopes, stony

Composition

Rockwood and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Drumlins

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.2 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Becida and similar soils
- Runeberg and similar soils
- Paddock and similar soils
- Blowers and similar soils
- Areas that have slopes of more than 6 percent
- Soils that have outwash over till

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1319C—Rockwood sandy loam, 6 to 12 percent slopes, stony

Composition

Rockwood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drumlins

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Becida and similar soils
- Runeberg and similar soils
- Paddock and similar soils
- Blowers and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Soils that have outwash over till

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1319D—Rockwood sandy loam, 12 to 20 percent slopes, stony

Composition

Rockwood and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Drumlins

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.5 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Becida and similar soils
- Runeberg and similar soils
- Paddock and similar soils
- Blowers and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent
- Soils that have outwash over till

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Roliss Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Upper part—moderately slow; lower part—moderately slow or moderate

Landforms: Lake plains and moraines

Parent material: Till

Slope range: 0 to 1 percent

Taxonomic classification: Fine-loamy, mixed (calcareous), frigid Typic Endoaquolls

Typical Pedon

Roliss clay loam, 600 feet west and 125 feet north of the southeast corner of sec. 19, T. 131 N., R. 43 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; moderate medium subangular blocky structure parting to weak fine granular; friable; few fine roots; about 2 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—9 to 14 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate fine subangular blocky structure; friable; few fine roots; about 2 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Bg—14 to 17 inches; grayish brown (2.5Y 5/2) silty

clay loam; moderate fine subangular blocky structure; friable; few fine roots; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; about 2 percent gravel; strongly effervescent; slightly alkaline; clear wavy boundary.

2Cg1—17 to 27 inches; light brownish gray (2.5Y 6/2) loam; massive; friable; many medium distinct light olive brown (2.5Y 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) carbonate threads; about 3 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2Cg2—27 to 60 inches; light brownish gray (2.5Y 6/2) loam; massive; friable; many coarse prominent yellowish brown (10YR 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) carbonate threads; about 3 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 19 inches

Content of rock fragments: 0 to 15 percent throughout

A horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 or 1

Texture—clay loam or silty clay loam

Bg horizon:

Hue—2.5Y or 5Y

Value—3 to 5

Chroma—1 or 2

Texture—loam, sandy clay loam, clay loam, silty clay loam, silt loam, or fine sandy loam

2C horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—1 to 4

Texture—loam or clay loam

1240—Roliss clay loam

Composition

Roliss and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landforms: Flats and swales on lake plains and moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Doran and similar soils
- Hamerly and similar soils
- Quam and similar soils
- Parnell and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Roscommon Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 2 percent

Taxonomic classification: Mixed, frigid Mollic Psammaquents

Typical Pedon

Roscommon loamy sand, 50 feet north and 300 feet east of the southwest corner of sec. 33, T. 135 N., R. 38 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; common very fine and fine roots; about 2 percent gravel; moderately acid; clear smooth boundary.

Cg1—6 to 13 inches; dark grayish brown (10YR 4/2) sand; single grain; loose; few very fine roots; common medium prominent dark brown (7.5YR 4/4) Fe concentrations and common medium faint dark gray (10YR 4/1) Fe depletions; about 1 percent gravel; neutral; clear smooth boundary.

Cg2—13 to 23 inches; grayish brown (2.5Y 5/2) sand; single grain; loose; common medium prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) Fe concentrations; about 8 percent gravel; neutral; clear smooth boundary.

Cg3—23 to 46 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; few fine distinct light olive brown (2.5Y 5/4) Fe concentrations; about 1 percent gravel; neutral; clear smooth boundary.

Cg4—46 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; common medium prominent yellowish red (5YR 4/6) and common fine and medium prominent strong brown (7.5YR 5/6) Fe concentrations; few black (5YR 2/1) manganese concentrations; about 1 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 0 to 60 inches

Content of rock fragments: 0 to 10 percent gravel throughout

A or Ap horizon:

Hue—10YR or neutral

Value—2 or 3

Chroma—0 to 2

Texture—loamy sand

Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 to 6

Chroma—1 to 3

Texture—dominantly sand, coarse sand, loamy sand, or loamy coarse sand; thin subhorizons of fine sand in some pedons

1943—Roscommon loamy sand

Composition

Roscommon and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and swales on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glacial outwash

Flooding: None

Seasonal high water table: At the surface to 1 foot below the surface

Available water capacity to 60 inches or root-limiting layer: About 4.1 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Leafriver and similar soils
- Nidaros and similar soils
- Duelm and similar soils
- Hubbard and similar soils
- Meehan and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rosy Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landforms: Outwash plains and moraines

Parent material: Glaciofluvial deposits

Slope range: 0 to 3 percent

Taxonomic classification: Coarse-loamy, mixed Glossoaquic Eutroboralfs

Typical Pedon

Rosy fine sandy loam, in an area of Bluffcreek-Rosy complex, 650 feet north and 150 feet east of the southwest corner of sec. 24, T. 134 N., R. 36 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very friable; common fine and medium roots; slightly acid; abrupt smooth boundary.

E—9 to 11 inches; brown (10YR 5/3) sand, pale brown (10YR 6/3) dry; single grain; loose; common fine roots; slightly acid; clear smooth boundary.

E/B—11 to 26 inches; about 55 percent brown (10YR 4/3) loamy sand (E), 45 percent dark yellowish brown (10YR 4/4) sandy loam (Bt); weak medium subangular blocky structure; very friable; common fine and very fine roots; slightly acid; clear smooth boundary.

Bt1—26 to 34 inches; dark yellowish brown (10YR 4/4) fine sandy loam; moderate medium subangular blocky structure; friable; few fine and very fine roots; common discontinuous faint brown (10YR 4/3) and few patchy faint dark brown (10YR 3/3) clay films on faces of peds and in pores; common fine and medium distinct grayish brown (10YR 5/2) Fe depletions and few fine distinct strong brown (10YR 4/6) Fe concentrations; many discontinuous distinct light gray (10YR 7/2) fine sand coatings on faces of peds; neutral; clear smooth boundary.

Bt2—34 to 40 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; few very fine roots; common discontinuous faint brown (10YR 4/3) clay bridging and coatings on sand grains; common fine distinct grayish brown (10YR 5/2) Fe depletions; neutral; clear smooth boundary.

Bt3—40 to 48 inches; brown (10YR 4/3) loam; weak medium and coarse subangular blocky structure; friable; common patchy faint brown (10YR 3/3) clay films on faces of peds and in pores; many medium and coarse distinct gray (10YR 5/1) Fe depletions and common fine and medium distinct very dark grayish brown (10YR 3/2) Fe concentrations; neutral; clear smooth boundary.

2C—48 to 60 inches; stratified light yellowish brown (2.5Y 6/3) silt loam and very fine sandy loam and pale yellow (5Y 7/3) sand; massive; friable; common medium prominent brownish yellow (10YR 6/6) Fe concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 29 to 60 inches

Content of rock fragments: 0 to 3 percent gravel

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

E horizon:

Hue—10YR

Value—4 to 6

Chroma—1 or 2

Texture—loamy fine sand, loamy sand, loamy very fine sand, fine sandy loam, loam, sandy loam, or silt loam

EB, E/B, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 10YR

Value—4 or 5

Chroma—2 to 4

Texture—loam, fine sandy loam, very fine sandy loam, silt loam, or sandy loam

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 4

Texture—stratified fine sand, sand, loamy sand, loamy fine sand, fine sandy loam, very fine sandy loam, sandy loam, loam, or silt loam

624—Rosy sandy loam

Composition

Rosy and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Flats on moraines and outwash plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciofluvial deposits

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Hillview and similar soils
- Bluffcreek and similar soils
- Cathro and similar soils
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rothsay Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate; lower part—moderate or moderately rapid

Landform: Moraines

Parent material: Glaciolacustrine deposits

Slope range: 1 to 18 percent

Taxonomic classification: Coarse-silty, mixed Udic Haploborolls

Typical Pedon

Rothsay silt loam, 800 feet east and 4,800 feet north of the southwest corner of sec. 10, T. 133 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—9 to 14 inches; very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.

Bw—14 to 22 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium prismatic structure parting to moderate fine subangular blocky; friable; common fine roots; neutral; clear wavy boundary.

Bk—22 to 31 inches; brown (10YR 5/3) silt loam; weak medium subangular blocky structure; friable; few fine roots; common fine irregular light gray (10YR 7/2) carbonate threads; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—31 to 60 inches; yellowish brown (10YR 5/4) very fine sandy loam; weak thin platy soil fragments; very friable; few fine irregular light gray (10YR 7/2) carbonate threads; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 12 to 30 inches

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: Typically none throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—silt loam

Bw horizon:

Hue—10YR

Value—3 to 5

Chroma—2 to 4

Texture—silt loam or very fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—silt loam, loam, or very fine sandy loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—2 to 4

Texture—silt loam or very fine sandy loam

290—Rothsay silt loam

Composition

Rothsay and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 12.8 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Zell and similar soils
- Hantho and similar soils
- Quam and similar soils
- Soils that have carbonates at or near the surface
- Areas that have slopes of more than 3 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

957B2—Rothsay-Zell complex, 2 to 6 percent slopes, eroded

Composition

Rothsay and similar soils: About 55 percent
 Zell and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Rothsay

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 12.7 inches
Organic matter content: High

Zell

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.8 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils
- Quam and similar soils
- Lakepark and similar soils
- Areas that have slopes of more than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Runeberg Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Upper part—moderate; next part—moderately slow; lower part—moderately slow or slow
Landform: Drumlins
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Coarse-loamy, mixed, frigid Typic Endoaquolls

Typical Pedon

Runeberg mucky loam, depressional, 2,500 feet south and 2,380 feet west of the northeast corner of sec. 13, T. 137 N., R. 36 W.

A—0 to 10 inches; black (N 2/0) mucky loam, very

dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bg1—10 to 14 inches; dark gray (10YR 4/1) loam; weak medium subangular blocky structure; friable; common fine roots; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 1 percent gravel; neutral; clear smooth boundary.

Bg2—14 to 21 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; friable; few fine roots; common medium prominent brown (7.5YR 5/4) and strong brown (7.5YR 5/6) Fe concentrations; about 1 percent gravel; neutral; clear smooth boundary.

Bg3—21 to 36 inches; grayish brown (2.5Y 5/2) sandy loam; weak medium subangular blocky structure; friable; common coarse prominent strong brown (7.5YR 5/6) Fe concentrations; about 1 percent gravel; slightly alkaline; clear smooth boundary.

Cg1—36 to 48 inches; light brownish gray (2.5Y 6/2) sandy loam; massive; friable; few medium prominent strong brown (7.5YR 5/6) Fe concentrations; few light gray (10YR 7/2) carbonate concentrations; about 1 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

Cg2—48 to 60 inches; light olive gray (5Y 6/2) sandy loam; massive; firm; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; few light gray (10YR 7/2) carbonate concentrations; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 36 inches

Thickness of the mollic epipedon: 8 to 20 inches

Content of rock fragments: 3 to 15 percent throughout

A horizon:

Hue—10YR to 5Y or neutral

Value—2 or 3

Chroma—0 to 2

Texture—mucky loam

Bg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—4 or 5

Chroma—1 or 2

Texture—sandy loam or loam

Cg horizon:

Hue—10YR, 2.5Y, or 5Y

Value—5 or 6

Chroma—1 or 2

Texture—sandy loam

701—Runeberg mucky loam, depressional

Composition

Runeberg and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions between drumlins

Slope range: 0 to 1 percent

Component Description

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Till

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 8.3 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Rockwood and similar soils
- Blowers and similar soils
- Paddock and similar soils
- Becida and similar soils
- Cathro and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rushlake Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Rapid

Landform: Lakeshores

Parent material: Beach deposits
Slope range: 0 to 3 percent
Taxonomic classification: Mixed, frigid Aquic
 Udipsamments

Typical Pedon

Rushlake sand, 2,950 feet west and 4,680 feet north of the southeast corner of sec. 20, T. 136 N., R. 40 W.

- A—0 to 5 inches; very dark grayish brown (10YR 3/2) sand, grayish brown (10YR 5/2) dry; single grain; loose; many fine and very fine roots; about 11 percent gravel; neutral; abrupt smooth boundary.
- C1—5 to 22 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; few very fine roots; about 31 percent gravel; slightly effervescent; moderately alkaline; clear smooth boundary.
- C2—22 to 30 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; about 18 percent gravel; slightly effervescent; strongly alkaline; clear smooth boundary.
- C3—30 to 42 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand; single grain; loose; about 23 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.
- C4—42 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; single grain; loose; about 25 percent gravel; slightly effervescent; strongly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 60 inches
Content of rock fragments: 0 to 35 percent throughout

A horizon:

Hue—10YR
 Value—2 to 4
 Chroma—1 to 3
 Texture—sand or loamy sand

C horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 6
 Texture—coarse sand, loamy coarse sand, sand, or loamy sand

1120—Rushlake-Hangaard complex

Composition

Rushlake and similar soils: About 55 percent
 Hangaard and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Lakeshores
Slope range: Rushlake—0 to 3 percent; Hangaard—0 to 2 percent

Component Description

Rushlake

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: 2.5 to 3.5 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderate

Hangaard

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Beach deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 2.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corliss and similar soils
- Leafriver and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1307—Rushlake sand

Composition

Rushlake and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Lakeshores

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Sand

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Beach deposits

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 3.6 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corliss and similar soils
- Bluffcreek and similar soils
- Hangaard and similar soils
- Leafriver and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Sandberg Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Upper part—moderately rapid or rapid;
lower part—rapid or very rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 20 percent

Taxonomic classification: Sandy, mixed Udorthentic
Haploborolls

Typical Pedon

Sandberg loamy sand, 1 to 6 percent slopes (fig. 20),

1,380 feet north and 800 feet west of the southeast corner of sec. 33, T. 134 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) loamy sand, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; common fine and medium roots; about 4 percent gravel; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark brown (10YR 2/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; common fine and medium roots; about 20 percent gravel; slightly acid; gradual wavy boundary.

Bw—12 to 19 inches; dark yellowish brown (10YR 3/4) gravelly loamy coarse sand; single grain; loose; about 17 percent gravel; neutral; clear wavy boundary.

Bk—19 to 29 inches; light olive brown (2.5Y 5/4) gravelly coarse sand; single grain; loose; common coarse distinct light gray (10YR 7/2) carbonate coatings on the underside of pebbles; about 25 percent gravel; slightly effervescent; slightly alkaline; diffuse wavy boundary.

C—29 to 80 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches

Thickness of the mollic epipedon: 7 to 16 inches

Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand

Content of rock fragments—0 to 15 percent by volume

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand, loamy coarse sand, sandy loam, coarse sandy loam, sand, or coarse sand or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent by volume

Bw horizon:

Hue—10YR or 7.5YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, coarse sand, or sand or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent by volume

Bk horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—coarse sand, sand, or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent by volume

C horizon:

Hue—10YR or 7.5YR

Value—4 to 6

Chroma—2 to 6

Texture—coarse sand, sand, or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent by volume

258A—Sandberg loamy sand, 0 to 2 percent slopes

Composition

Sandberg and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats on outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hubbard and similar soils
- Dorset and similar soils

- Duelm and similar soils
- Isan and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

258B—Sandberg loamy sand, 1 to 6 percent slopes

Composition

Sandberg and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Summits and backslopes

Slope range: 1 to 6 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Radium and similar soils
- Isan and similar soils
- Areas that have slopes of more than 6 percent or less than 1 percent
- Nidaros and similar soils
- Forada and similar soils

Major Uses of the Unit

- Cropland
- Hayland

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

258C—Sandberg loamy sand, 6 to 12 percent slopes

Composition

Sandberg and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Clontarf and similar soils
- Isan and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Nidaros and similar soils
- Forada and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1219C—Sandberg-Sverdrup complex, 6 to 12 percent slopes

Composition

Sandberg and similar soils: About 55 percent
Sverdrup and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Sandberg

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches
Organic matter content: Moderate

Sverdrup

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Forada and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1223D—Sandberg-Arvilla complex, 12 to 20 percent slopes

Composition

Sandberg and similar soils: About 65 percent

Arvilla and similar soils: About 25 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description

Sandberg

Texture of the surface layer: Coarse sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.3 inches

Organic matter content: Moderate

Arvilla

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Fordville and similar soils
- Clontarf and similar soils
- Forada and similar soils
- Leafriver and similar soils

- Nidaros and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sedgeville Series

Depth class: Very deep

Drainage class: Poorly drained and very poorly drained

Permeability: Upper part—moderate or moderately rapid; next part—moderate; lower part—rapid or very rapid

Landform: Flood plains

Parent material: Alluvium

Slope range: 0 to 2 percent slopes

Taxonomic classification: Coarse-loamy, mixed, frigid Fluvaquentic Endoaquolls

Typical Pedon

Sedgeville loam, frequently flooded, 1,300 feet east and 200 feet south of the northwest corner of sec. 3, T. 138 N., R. 38 W., in Becker County, Minnesota:

A—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very friable; common fine and medium roots; about 1 percent gravel; neutral; clear wavy boundary.

Bg—8 to 17 inches; grayish brown (2.5Y 5/2) sandy loam; moderate medium subangular blocky structure; very friable; few fine and very fine roots; few fine prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel; neutral; clear wavy boundary.

Cg1—17 to 34 inches; grayish brown (2.5Y 5/2) coarse sandy loam; massive; very friable; few very fine roots; few fine prominent strong brown (7.5YR 5/6) Fe concentrations; about 10 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2Cg2—34 to 60 inches; grayish brown (2.5Y 5/2) gravelly loamy coarse sand with dark grayish brown (2.5Y 4/2) strata of silt loam and sandy loam; massive; about 30 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At or near the surface
Thickness of the mollic epipedon: 7 to 16 inches
Thickness of loamy alluvium: 24 to 40 inches

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral
 Value—2 or 3
 Chroma—0 to 3
 Texture—loam
 Content of rock fragments—0 to 15 percent

Bg horizon:

Hue—10YR, 2.5Y, or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam, silt loam, sandy loam, fine sandy loam, or coarse sandy loam
 Content of rock fragments—0 to 15 percent

Cg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—loam, silt loam, sandy loam, fine sandy loam, or coarse sandy loam or stratified with these textures
 Content of rock fragments—0 to 15 percent

2Cg horizon:

Hue—2.5Y or 5Y
 Value—5 or 6
 Chroma—1 or 2
 Texture—sand, coarse sand, loamy sand, or loamy coarse sand or the gravelly analogs of these textures
 Content of rock fragments—0 to 35 percent

1291—Sedgeville loam, frequently flooded

Composition

Sedgeville and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Alluvium
Frequency of flooding: Frequent

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Nidaros and similar soils
- Forada and similar soils
- Soils that formed in sands
- Moderately well drained soils
- Areas that are not subject to flooding

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1293—Sedgeville fine sandy loam, rarely flooded

Composition

Sedgeville and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Alluvium
Frequency of flooding: Rare
Depth to the water table: 0.5 foot to 1.5 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this

section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Nidaros and similar soils
- Forada and similar soils
- Soils that formed in sands
- Moderately well drained soils
- Areas that are frequently flooded

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1396—Sedgeville, Nidaros, and Aquolls soils, channeled

Composition

Sedgeville and similar soils: About 30 percent
 Nidaros and similar soils: About 30 percent
 Aquolls and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Sedgeville—meandering channels;
 Nidaros—depressions on flood plains; Aquolls—
 rises on flood plains and terraces
Slope range: Sedgeville—0 to 2 percent; Nidaros—0 to
 1 percent; Aquolls—0 to 2 percent

Component Description

Sedgeville

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Alluvium
Frequency of flooding: Frequent
Seasonal high water table: 1.0 foot above to 0.5 foot
 below the surface
Ponding duration: Very long
*Available water capacity to 60 inches or root-limiting
 layer:* About 7.8 inches
Organic matter content: Very high

Nidaros

Texture of the surface layer: Muck
Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot
 below the surface

Ponding duration: Very long

*Available water capacity to 60 inches or root-limiting
 layer:* About 11.3 inches

Organic matter content: Very high

Aquolls

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Flooding: None

Seasonal high water table: 0.5 foot above to 1.5 feet
 below the surface

Ponding duration: Very long

*Available water capacity to 60 inches or root-limiting
 layer:* About 9.5 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section for the Sedgeville and Nidaros soils. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Wykeham and similar soils
- Kandota and similar soils
- Lida and similar soils
- Oylen and similar soils
- Duelm and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Seelyeville Series

Depth class: Very deep

Drainage class: Very poorly drained

Permeability: Moderately slow to moderately rapid

Landforms: Lake plains and moraines

Parent material: Organic materials

Slope range: 0 to 10 percent

Taxonomic classification: Euic Typic Borosaprists

Typical Pedon

Seelyeville muck, 2,225 feet north and 2,075 feet west of the southeast corner of sec. 4, T. 137 N., R. 36 W.

Oa1—0 to 8 inches; muck (sapric material), black (7.5YR 2/0) broken face and black (10YR 2/1) rubbed; about 30 percent fibers, 2 percent rubbed; weak medium subangular blocky structure; friable; neutral; abrupt wavy boundary.

Oa2—8 to 70 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 10 percent fibers, 1 percent rubbed; weak medium subangular blocky structure; friable; few thin seams of hemic material less than 2 inches thick with a combined thickness of less than 10 inches; slightly acid; clear smooth boundary.

Oa3—70 to 80 inches; muck (sapric material), black (7.5YR 2/0) broken face and black (10YR 2/1) rubbed; about 10 percent fibers, 2 percent rubbed; weak medium subangular blocky structure; friable; slightly acid.

Range in Characteristics

Thickness of the histic epipedon: Greater than 51 inches

Depth to carbonates: Typically greater than 60 inches

Oa horizon:

Hue—10YR, 7.5YR, or neutral

Value—2 or 3

Chroma—0 to 2

Texture—muck

540—Seelyeville muck

Composition

Seelyeville and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landforms: Depressions on lake plains, outwash plains, and moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Epoufette and similar soils
- Egglake and similar soils
- Bluffton and similar soils
- Runeberg and similar soils
- Bluffcreek and similar soils

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1825B—Seelyeville muck, seep land, 1 to 10 percent slopes

Composition

Seelyeville and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Seeps (sidehill seeps)

Slope range: 1 to 10 percent

Component Description

Texture of the surface layer: Muck

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Organic materials

Flooding: None

Seasonal high water table: At the surface to 2 feet below the surface

Available water capacity to 60 inches or root-limiting layer: About 24.0 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandota and similar soils
- Lida and similar soils
- Bluffton and similar soils
- Pinelake and similar soils
- Brandsvold and similar soils
- Areas that have slopes of more than 10 percent

Major Uses of the Unit

- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sioux Series

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Upper part—moderately rapid; lower part—rapid or very rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 2 to 40 percent

Taxonomic classification: Sandy-skeletal, mixed Udorthentic Haploborolls

Typical Pedon

Sioux loamy sand, 2 to 12 percent slopes, 1,250 feet west and 1,425 feet north of the southeast corner of sec. 29, T. 132 N., R. 39 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few fine roots; about 5 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

A—10 to 14 inches; very dark grayish brown (10YR 3/2) gravelly loamy sand, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few fine and very fine roots; about 15 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

C—14 to 60 inches; light olive brown (2.5Y 5/3) very gravelly coarse sand; single grain; loose; about 50 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Thickness of the mollic epipedon: 7 to 14 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1

Texture—loamy sand

Content of rock fragments—5 to 35 percent

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—stratified with gravelly sand, gravelly coarse sand, or the very gravelly or extremely gravelly analogs of these textures

Content of rock fragments—averages 35 to 60 percent

402C—Sioux loamy sand, 2 to 12 percent slopes

Composition

Sioux and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 2 to 12 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.3 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Sandberg and similar soils
- Radium and similar soils
- Soils in which carbonates have been leached to the subsoil

- Areas that have slopes of more than 12 percent
- Poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

402E—Sioux loamy sand, 12 to 40 percent slopes

Composition

Sioux and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 12 to 40 percent

Component Description

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.3 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Arvilla and similar soils
- Soils in which carbonates have been leached to the subsoil
- Radium and similar soils
- Areas that have slopes of more than 40 percent or less than 12 percent
- Sandberg and similar soils
- Nidaros and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sisseton Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 2 to 30 percent

Taxonomic classification: Coarse-loamy, mixed, frigid
Typic Eutrochrepts

Typical Pedon

Sisseton loam, in an area of Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded, 1,650 feet east and 1,900 feet north of the southwest corner of sec. 6, T. 135 N., R. 43 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, light grayish brown (10YR 6/2) dry; weak very fine granular structure; very friable; many fine roots; about 6 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—9 to 19 inches; light yellowish brown (10YR 6/4) loam; weak medium platy structure parting to weak fine subangular blocky; very friable; few fine roots; common discontinuous distinct white (10YR 8/2) carbonate coatings on faces of peds; about 5 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

C—19 to 60 inches; pale brown (10YR 6/3) sandy loam; massive; very friable; few discontinuous distinct white (10YR 8/2) carbonate coatings on faces of peds; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 8 inches

Content of rock fragments: 1 to 10 percent throughout

A horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—2 to 4

Texture—loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—loam or silt loam

C horizon:

Hue—2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—sandy loam or loam

777C2—Sisseton-Heimdal complex, 6 to 12 percent slopes, eroded**Composition**

Sisseton and similar soils: About 55 percent

Heimdal and similar soils: About 35 percent

Inclusions: About 10 percent

Setting*Landform:* Moraines*Position on the landform:* Backslopes and shoulders*Slope range:* 6 to 12 percent**Component Description****Sisseton***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 10.1 inches*Organic matter content:* Moderate**Heimdal***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 9.1 inches*Organic matter content:* High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darnen and similar soils
- Lakepark and similar soils
- Quam and similar soils

- Cathro and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

777D2—Sisseton-Heimdal complex, 12 to 20 percent slopes, eroded**Composition**

Sisseton and similar soils: About 60 percent

Heimdal and similar soils: About 30 percent

Inclusions: About 10 percent

Setting*Landform:* Moraines*Position on the landform:* Backslopes and shoulders*Slope range:* 12 to 20 percent**Component Description****Sisseton***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 10.1 inches*Organic matter content:* Moderate**Heimdal***Texture of the surface layer:* Loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Till*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 9.0 inches*Organic matter content:* High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit,

such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darnen and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

777E—Sisseton-Heimdal complex, 20 to 30 percent slopes

Composition

Sisseton and similar soils: About 70 percent
Heimdal and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 20 to 30 percent

Component Description

Sisseton

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.1 inches

Organic matter content: Moderate

Heimdal

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.9 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darnen and similar soils
- Lakepark and similar soils
- Quam and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 30 percent or less than 20 percent

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Snellman Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 45 percent

Taxonomic classification: Fine-loamy, mixed Typic Eutroboralfs

Typical Pedon

Snellman sandy loam, 2 to 8 percent slopes (fig. 21), 1,300 feet east and 1,300 feet south of the northwest corner of sec. 4, T. 137 N., R. 38 W.

Ap—0 to 9 inches; brown (10YR 4/3) sandy loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine and medium roots; neutral; about 3 percent gravel; abrupt smooth boundary.

E—9 to 12 inches; brown (10YR 5/3) sandy loam, light gray (10YR 7/2) dry; weak thin platy structure; friable; common fine and medium roots; about 3 percent gravel; neutral; clear irregular boundary.

Bt1—12 to 15 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate fine subangular blocky structure; firm; many continuous faint brown

(10YR 5/3) sand skeletons on vertical faces of peds; common fine and medium roots; about 3 percent gravel; slightly alkaline; clear irregular boundary.

Bt2—15 to 19 inches; dark yellowish brown (10YR 4/4) sandy clay loam; strong medium subangular blocky structure; firm; few fine and medium roots; common discontinuous faint brown (10YR 4/3) clay films and common patchy faint dark brown (10YR 3/3) clay films on faces of peds and in pores; few discontinuous faint brown (10YR 5/3) sand skeletons on vertical faces of peds; about 3 percent gravel; slightly alkaline; clear wavy boundary.

Bt3—19 to 31 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate medium subangular blocky structure; firm; few fine and medium roots; common discontinuous faint brown (10YR 4/3) clay films on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

C—31 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; massive; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 42 inches

Content of rock fragments: 2 to 15 percent throughout

Other features: Some pedons have an EB, E/B, B/E, or BE horizon.

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam or fine sandy loam

E horizon:

Hue—10YR

Value—5 or 6

Chroma—3 or 4

Texture—loamy sand, loamy fine sand, fine sandy loam, or sandy loam

EB, E/B, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—3 to 5

Chroma—3 or 4

Texture—dominantly sandy clay loam; subhorizons of loam, sandy loam, clay loam, or fine sandy loam in some pedons

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—sandy loam, fine sandy loam, or loam

267B—Snellman sandy loam, 2 to 8 percent slopes

Composition

Snellman and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 8 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 8 percent
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

267C—Snellman sandy loam, 8 to 15 percent slopes

Composition

Snellman and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 8 to 15 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 15 percent or less than 8 percent
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

267E—Snellman sandy loam, 15 to 30 percent slopes

Composition

Snellman and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 15 to 30 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Soils that have slopes of more than 30 percent or less than 15 percent
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

267F—Snellman sandy loam, 30 to 45 percent slopes

Composition

Snellman and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 30 to 45 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 45 percent or less than 30 percent
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

776B—Snellman-Sugarbush complex, 2 to 8 percent slopes

Composition

Snellman and similar soils: About 60 percent
Sugarbush and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 8 percent

Component Description

Snellman

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches
Organic matter content: Moderate

Sugarbush

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Epoufette and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Bluffton and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

- Forest Land section

776C—Snellman-Sugarbush complex, 8 to 15 percent slopes

Composition

Snellman and similar soils: About 60 percent
 Sugarbush and similar soils: About 30 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 8 to 15 percent

Component Description

Snellman

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

Sugarbush

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Epoufette and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

776E—Snellman-Sugarbush complex, 15 to 30 percent slopes

Composition

Snellman and similar soils: About 55 percent
 Sugarbush and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 15 to 30 percent

Component Description

Snellman

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

Sugarbush

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in

this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Epoufette and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Egglake and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1218B—Snellman-Lida complex, 1 to 8 percent slopes

Composition

Snellman and similar soils: About 55 percent

Lida and similar soils: About 30 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 1 to 8 percent

Component Description

Snellman

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches

Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.0 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1218C—Snellman-Lida complex, 8 to 15 percent slopes

Composition

Snellman and similar soils: About 45 percent

Lida and similar soils: About 40 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 8 to 15 percent

Component Description

Snellman

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches
Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1218E—Snellman-Lida complex, 15 to 30 percent slopes

Composition

Snellman and similar soils: About 55 percent
 Lida and similar soils: About 30 percent
 Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 15 to 30 percent

Component Description

Snellman

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.4 inches
Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.1 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1218F—Snellman-Lida complex, 30 to 45 percent slopes

Composition

Snellman and similar soils: About 55 percent

Lida and similar soils: About 30 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 30 to 45 percent

Component Description

Snellman

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches
Organic matter content: Moderate

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.6 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Two Inlets and similar soils
- Wykeham and similar soils
- Areas that have stones on the surface

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Sugarbush Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Upper part—moderately rapid; lower part—rapid or very rapid
Landforms: Moraines
Parent material: Glacial outwash
Slope range: 2 to 30 percent
Taxonomic classification: Coarse-loamy, mixed Typic Eutroboralfs

Typical Pedon

Sugarbush sandy loam, in an area of Snellman-Sugarbush complex, 2 to 8 percent slopes, 1,400 feet west and 1,300 feet south of the northeast corner of sec. 15, T. 142 N., R. 40 W., in Becker County, Minnesota:

- A—0 to 3 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; about 3 percent gravel; moderately acid; clear smooth boundary.
- E—3 to 13 inches; brown (10YR 5/3) loamy sand, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; very friable; about 3 percent gravel; slightly acid; gradual smooth boundary.
- Bt—13 to 25 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; many continuous distinct dark brown (7.5YR 4/4) clay films on faces of peds and in pores; about 5 percent gravel; slightly acid; clear smooth boundary.
- 2C—25 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; few coatings of carbonate on the underside of pebbles; about 20 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Depth to sand and gravel: 15 to 30 inches
Content of rock fragments: 0 to 15 percent in the loamy mantle; 10 to 35 percent in the underlying sediments

A or Ap horizon:

Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 15 percent

E horizon:

Hue—10YR

Value—4 to 6
 Chroma—3 or 4
 Texture—loamy sand or loamy coarse sand
 Content of rock fragments—0 to 15 percent

Bt horizon:

Hue—10YR or 7.5YR
 Value—3 to 5
 Chroma—3 to 6
 Texture—sandy loam or coarse sandy loam
 Content of rock fragments—0 to 15 percent

2C horizon:

Hue—10YR or 7.5YR
 Value—5 or 6
 Chroma—3 to 6
 Texture—sand, coarse sand, or the gravelly analogs of these textures
 Content of rock fragments—10 to 35 percent

Sverdrup Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 18 percent

Taxonomic classification: Sandy, mixed Udic Haploborolls

Typical Pedon

Sverdrup sandy loam, 2 to 6 percent slopes, 200 feet east and 2,620 feet north of the southwest corner of sec. 28, T. 131 N., R. 43 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak medium and coarse subangular blocky structure; friable; common fine and medium roots; neutral; abrupt smooth boundary.

A—9 to 12 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; common fine and very fine roots; neutral; clear wavy boundary.

Bw1—12 to 19 inches; brown (10YR 4/3) sandy loam; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; friable; few fine and very fine roots; very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) coatings on faces of prisms; neutral; gradual wavy boundary.

2Bw2—19 to 24 inches; dark grayish brown (10YR

4/2) loamy sand; weak medium subangular blocky structure; friable; few very fine roots; slightly alkaline; clear wavy boundary.

2C1—24 to 31 inches; brown (10YR 4/3) sand; single grain; loose; slightly effervescent; moderately alkaline; clear irregular boundary.

2C2—31 to 48 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few fine rounded soft masses of lime; slightly effervescent; moderately alkaline; clear irregular boundary.

2C3—48 to 60 inches; olive brown (2.5Y 5/3) sand; single grain; loose; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 15 to 44 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 14 to 24 inches

A horizon:

Hue—10YR
 Value—2 or 3
 Chroma—1 or 2
 Texture—sandy loam
 Content of rock fragments—0 to 5 percent

Bw horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—2 to 4
 Texture—fine sandy loam, sandy loam, or loam
 Content of rock fragments—0 to 5 percent

2Bw horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—2 to 4
 Texture—loamy fine sand, loamy sand, fine sand, or sand
 Content of rock fragments—0 to 5 percent

2C horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 4
 Texture—sand, fine sand, or loamy sand
 Content of rock fragments—0 to 10 percent

127A—Sverdrup sandy loam, 0 to 2 percent slopes**Composition**

Sverdrup and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats and slight rises on pitted outwash plains
Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Fordville and similar soils
- Oylen and similar soils
- Sandberg and similar soils
- Forada and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

127B—Sverdrup sandy loam, 2 to 6 percent slopes**Composition**

Sverdrup and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Fordville and similar soils
- Sandberg and similar soils
- Forada and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

127C—Sverdrup sandy loam, 6 to 12 percent slopes**Composition**

Sverdrup and similar soils: About 85 percent
 Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Fordville and similar soils
- Sandberg and similar soils
- Forada and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Very poorly drained soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1221B—Sverdrup-Sandberg complex, 2 to 6 percent slopes**Composition**

Sverdrup and similar soils: About 50 percent
Sandberg and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description**Sverdrup**

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.8 inches
Organic matter content: Moderate

Sandberg

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.4 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Clontarf and similar soils
- Oylen and similar soils
- Forada and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Swenoda Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Upper part—moderately rapid; lower part—moderately slow or moderate
Landforms: Lake plains and moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 1 to 4 percent
Taxonomic classification: Coarse-loamy, mixed Pachic Udic Haploborolls

Typical Pedon

Swenoda fine sandy loam, 1 to 4 percent slopes, 400 feet north and 2,200 feet west of the southeast corner of sec. 32, T. 132 N., R. 44 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; many

fine and medium roots; neutral; abrupt smooth boundary.

A—9 to 15 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine and medium subangular blocky structure; friable; many fine and medium roots; neutral; clear smooth boundary.

Bw1—15 to 22 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; many fine and medium roots; neutral; clear smooth boundary.

Bw2—22 to 29 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; many very fine and fine roots; neutral; abrupt smooth boundary.

2Bk—29 to 40 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic soil fragments; firm; few very fine and fine roots; common medium and coarse prominent yellowish brown (10YR 5/8) and light olive brown (2.5Y 5/6) Fe concentrations; many distinct light gray (10YR 7/2) carbonate coatings on faces of peds and in pores; many fine rounded light gray (10YR 7/2) carbonate nodules; about 2 percent gravel; violently effervescent; moderately alkaline; gradual smooth boundary.

2C—40 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic soil fragments; firm; common fine and medium distinct light olive brown (2.5Y 5/6) Fe concentrations; few distinct light gray (10YR 7/2) carbonate coatings on faces of peds and in pores; few fine rounded light gray (10YR 7/2) carbonate nodules; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches

Thickness of the mollic epipedon: 16 to 24 inches

Depth to glacial till: 20 to 40 inches

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Content of rock fragments—0 to 3 percent

Bw horizon:

Hue—10YR or 2.5Y

Value—2 to 4

Chroma—1 to 4

Texture—sandy loam or fine sandy loam

Content of rock fragments—0 to 15 percent

2Bk horizon:

Hue—2.5Y or 5Y

Value—4 to 6

Chroma—2 to 6

Texture—loam or clay loam

Content of rock fragments—1 to 3 percent

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 6

Texture—loam or clay loam

Content of rock fragments—1 to 10 percent

293B—Swenoda fine sandy loam, 1 to 4 percent slopes

Composition

Swenoda and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Flats and rises on lake plains and moraines

Slope range: 1 to 4 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 4.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.8 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamerly and similar soils
- Areas that have slopes of more than 4 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sybil Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Upper part—moderately rapid; lower part—rapid

Landforms: Kame moraines and pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 30 percent

Taxonomic classification: Coarse-loamy, mixed Mollic Eutroboralfs

Typical Pedon

Sybil loamy sand, in an area of Sybil-Eagleview complex, 2 to 8 percent slopes, 3,850 feet north and 1,400 feet west of the southeast corner of sec. 16, T. 135 N., R. 39 W.

Ap—0 to 5 inches; dark brown (10YR 3/3) loamy sand, brown (10YR 5/3) dry; weak fine and medium granular structure; very friable; common fine roots; slightly acid; clear smooth boundary.

E—5 to 10 inches; dark yellowish brown (10YR 4/4) loamy sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; few fine roots; neutral; clear smooth boundary.

Bt1—10 to 15 inches; dark brown (7.5YR 4/4) sandy loam; moderate fine and medium subangular blocky structure; friable; few fine roots; common continuous distinct dark brown (10YR 3/3) clay films on faces of peds and in pores; common discontinuous prominent white (10YR 8/2) sand coatings on faces of peds; neutral; clear smooth boundary.

Bt2—15 to 23 inches; dark brown (7.5YR 4/4) loamy sand; single grain; loose; few fine roots; common patchy faint dark brown (7.5YR 3/4) clay bridging between sand grains; neutral; gradual smooth boundary.

Bt3—23 to 32 inches; dark yellowish brown (10YR 4/4) loamy sand; single grain; loose; common discontinuous distinct dark brown (7.5YR 4/4) clay occurring as bridges between sand grains and as thin lamellae; neutral; gradual smooth boundary.

C—32 to 80 inches; brown (10YR 5/4) sand; single grain; loose; about 5 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches

Content of rock fragments: 0 to 10 percent

Other features: Some pedons have a BE, B/E, or E&Bt horizon either above or below the Bt horizon.

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 3

Texture—loamy sand or sandy loam

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—loamy sand, loamy coarse sand, or loamy fine sand

E&Bt, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—7.5YR or 10YR

Value—3 to 5

Chroma—3 to 6

Texture—dominantly sandy loam, coarse sandy loam, or fine sandy loam; subhorizons of sandy clay loam, loam, loamy sand, loamy fine sand, or sand in some pedons

2C horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—5 to 7

Chroma—2 to 6

Texture—sand or coarse sand

1195A—Sybil-Eagleview complex, 0 to 2 percent slopes

Composition

Sybil and similar soils: About 70 percent

Eagleview and similar soils: About 25 percent

Inclusions: About 5 percent

Setting

Landform: Flats on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Sybil

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.2 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Pinelake and similar soils
- Forada and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1195B—Sybil-Eagleview complex, 2 to 8 percent slopes

Composition

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landforms: Kame moraines and pitted outwash plains

Position on the landform: Summits and backslopes

Slope range: 2 to 8 percent

Component Description

Sybil

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.0 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Forada and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 8 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1195C—Sybil-Eagleview complex, 8 to 15 percent slopes

Composition

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landforms: Kame moraines and pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 8 to 15 percent

Component Description**Sybil**

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.6 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Forada and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 15 percent or less than 8 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1195E—Sybil-Eagleview complex, 15 to 30 percent slopes**Composition**

Sybil and similar soils: About 60 percent

Eagleview and similar soils: About 30 percent

Inclusions: About 10 percent

Setting

Landforms: Kame moraines and pitted outwash plains

Position on the landform: Backslopes and shoulders

Slope range: 15 to 30 percent

Component Description**Sybil**

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 6.6 inches

Organic matter content: Moderate

Eagleview

Texture of the surface layer: Loamy sand

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 4.7 inches

Organic matter content: Moderately low

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bluffcreek and similar soils
- Almora and similar soils
- Pinelake and similar soils
- Forada and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 30 percent or less than 15 percent

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Two Inlets Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderately rapid; lower part—rapid or very rapid

Landforms: Kame moraines and pitted outwash plains

Parent material: Glacial outwash

Slope range: 1 to 50 percent

Taxonomic classification: Sandy, mixed Psammentic Eutroboralfs

Typical Pedon

Two Inlets sandy loam, in an area of Lida-Two Inlets complex, 8 to 15 percent slopes, 250 feet south and 1,400 feet east of the northwest corner of sec. 33, T. 136 N., R. 41 W.

A—0 to 4 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; many fine and medium roots; about 2 percent gravel; neutral; abrupt smooth boundary.

E—4 to 9 inches; brown (10YR 4/3) loamy coarse sand, brown (10YR 5/3) dry; weak fine subangular blocky structure; very friable; common fine to coarse roots; many continuous faint dark brown (10YR 3/3) and few patchy faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; about 8 percent gravel; neutral; abrupt smooth boundary.

Bt—9 to 11 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; few medium roots; common patchy distinct very dark grayish brown (10YR 3/2) clay films on faces of peds; about 5 percent gravel; slightly acid; clear irregular boundary.

E&Bt—11 to 30 inches; sand, dark yellowish brown (10YR 4/4) (E) and dark brown (10YR 3/3) (Bt); weak fine subangular blocky structure; very friable; few medium roots; few discontinuous faint dark brown (10YR 3/3) clay bridging between sand grains; about 5 percent gravel; neutral; gradual wavy boundary.

BC—30 to 38 inches; dark yellowish brown (10YR 3/4) gravelly coarse sand; single grain; loose; few

medium roots; few faint dark brown (10YR 3/3) discontinuous clay bridging on sand and gravel; about 34 percent gravel; slightly effervescent; moderately alkaline; gradual irregular boundary.

C—38 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; about 29 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 14 to 40 inches

Other features: Some pedons have an EB, B/E, BE, or Bk horizon.

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loamy coarse sand, loamy sand, sandy loam, or coarse sandy loam or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent

E horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

Texture—loamy sand, loamy coarse sand, sand, or coarse sand or the gravelly analogs of these textures

Content of rock fragments—5 to 35 percent

EB, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 7.5YR

Value—3 or 4

Chroma—3 or 4

Texture—dominantly loamy sand, loamy coarse sand, coarse sand, or sand or the gravelly analogs of these textures; thin subhorizons of sandy loam or coarse sandy loam in some pedons

Content of rock fragments—5 to 35 percent

Bk horizon (if it occurs):

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 6

Texture—dominantly coarse sand, sand, or very coarse sand or the gravelly analogs of these textures; subhorizons that have more than 35 percent gravel in some pedons

Content of rock fragments—5 to 35 percent

C horizon:

Hue—10YR

Value—4 to 6

Chroma—3 to 6

Texture—dominantly coarse sand, sand, or very coarse sand or the gravelly analogs of these textures; subhorizons that have more than 35 percent gravel in some pedons

Content of rock fragments—15 to 35 percent

1015—Udipsamments (cut and fill land)***Composition***

Udipsamments: 95 percent

Inclusions: About 5 percent

Setting*Landforms:* Outwash plains, lake plains, and moraines*Slope range:* 0 to 10 percent***Component Description****Texture of the surface layer:* Sand*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 4.0 inches*Organic matter content:* Very low***Inclusions***

- Poorly drained soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

1016—Udorthents, loamy (cut and fill land)***Composition***

Udorthents: 95 percent

Inclusions: About 5 percent

Component Description*Texture of the surface layer:* Variable*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Organic matter content:* Very low***Inclusions***

- Poorly drained soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

1027—Udorthents, wet substratum (fill land)***Composition***

Udorthents: 95 percent

Inclusions: About 5 percent

Inclusions

- Moderately well drained soils

Major Uses of the Unit

- Wildlife habitat

For general and detailed information concerning these uses, see Part II of this publication:

- Wildlife Habitat section

Urness Series*Depth class:* Very deep*Drainage class:* Very poorly drained*Permeability:* Moderately slow or moderate*Landforms:* Moraines*Parent material:* Coprogenous earth*Slope range:* 0 to 1 percent*Taxonomic classification:* Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents***Typical Pedon***

Urness mucky silt loam, 900 feet west and 150 feet north of the southeast corner of sec. 33, T. 136 N., R. 44 W.

Ap—0 to 9 inches; black (N 2/0) mucky silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; many fine roots; 5 percent shell fragments; violently effervescent; moderately alkaline; abrupt smooth boundary.

C1—9 to 31 inches; very dark gray (N 3/0) mucky silt

loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; very friable; few fine roots; few fine prominent strong brown (7.5YR 4/6) Fe concentrations; 3 percent shell fragments; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—31 to 58 inches; black (10YR 2/1) mucky silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; very friable; common medium prominent strong brown (7.5YR 4/6) Fe concentrations; 3 percent shell fragments; strongly effervescent; moderately alkaline; gradual wavy boundary.

C3—58 to 60 inches; black (N 2/0) mucky silt loam, very dark gray (10YR 3/1) dry; massive; very friable; few fine prominent strong brown (7.5YR 4/6) Fe concentrations; 3 percent shell fragments; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches

Content of rock fragments: Typically none throughout

Ap horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 to 4

Chroma—0 to 2

Texture—mucky silt loam

C horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 to 4

Chroma—0 to 2

Texture—loam, silt loam, clay loam, or silty clay loam or the mucky analogs of these textures

Content of shell fragments (by volume)—1 to 25 percent; mostly fragments of snail shells and clam shells 2 to 10 mm in size

335—Urness mucky silt loam

Composition

Urness and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Depressions on moraines

Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Mucky silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Very poorly drained

Dominant parent material: Coprogenous earth

Flooding: None

Seasonal high water table: 1.0 foot above to 0.5 foot below the surface

Ponding duration: Very long

Available water capacity to 60 inches or root-limiting layer: About 11.6 inches

Organic matter content: Very high

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Roliss and similar soils
- Hamerly and similar soils
- Haslie and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Vallers Series

Depth class: Very deep

Drainage class: Poorly drained

Permeability: Moderately slow

Landforms: Lake plains and moraines

Parent material: Till

Slope range: 0 to 2 percent

Taxonomic classification: Fine-loamy, frigid Typic Calciaquolls

Typical Pedon

Vallers silty clay loam, 1,250 feet west and 1,400 feet north of the southeast corner of sec. 28, T. 131 N., R. 38 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, black (N 3/0) dry; weak fine and medium subangular blocky structure; friable; common fine and medium roots; about 2 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—8 to 14 inches; black (N 2/0) silty clay loam, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; common fine and medium roots;

about 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkg1—14 to 18 inches; gray (5Y 5/1) clay loam; weak fine and medium subangular blocky structure; friable; few fine roots; common fine and medium prominent light olive brown (2.5Y 5/4) Fe concentrations; common fine irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg2—18 to 24 inches; olive gray (5Y 5/2) clay loam; weak fine and medium subangular blocky structure; friable; common fine and medium prominent light olive brown (2.5Y 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) soft masses of carbonates; about 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Cg—24 to 60 inches; light olive gray (5Y 6/2) clay loam; massive; friable; many medium and coarse prominent yellowish brown (10YR 5/6) Fe concentrations; common fine irregular light gray (10YR 7/2) carbonate threads; common fine rounded soft masses of iron; about 2 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 25 inches

Content of rock fragments: 2 to 8 percent throughout

A horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—2 or 3

Chroma—0 or 1

Texture—silty clay loam

Bkg horizon:

Hue—10YR, 2.5Y, 5Y, or neutral

Value—3 to 6

Chroma—0 to 2

Texture—clay loam, silty clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y

Value—4 to 7

Chroma—1 to 3

Texture—loam or clay loam

1317—Vallers silty clay loam

Composition

Vallers and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landforms: Flats and swales on lake plains and moraines

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Silty clay loam

Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.0 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Quam and similar soils
- Hamerly and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Verndale Series

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Upper part—moderately rapid; next part—moderate; lower part—rapid

Landform: Pitted outwash plains

Parent material: Glacial outwash

Slope range: 0 to 12 percent

Taxonomic classification: Coarse-loamy, mixed Udic Argiborolls

Typical Pedon

Verndale sandy loam, 0 to 2 percent slopes, 175 feet west and 1,225 feet north of the southeast corner of sec. 30, T. 136 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; very friable; few fine roots; slightly acid; abrupt smooth boundary.

Bt1—9 to 12 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common fine roots; common continuous faint brown (10YR 3/3 and 4/3) clay films on faces of peds; about 1 percent gravel; neutral; clear smooth boundary.

Bt2—12 to 18 inches; dark yellowish brown (10YR 4/4) sandy loam; moderate medium subangular blocky structure; friable; common fine roots; common continuous faint brown (10YR 4/3) clay films on faces of peds; about 1 percent gravel; neutral; clear smooth boundary.

2Bt3—18 to 21 inches; dark yellowish brown (10YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine roots; few patchy faint brown (10YR 4/3) clay bridging between sand grains; about 1 percent gravel; neutral; clear smooth boundary.

2Bw—21 to 38 inches; yellowish brown (10YR 5/6) sand; single grain; loose; about 2 percent gravel; neutral; clear smooth boundary.

2C1—38 to 43 inches; yellowish brown (10YR 5/4) sand; single grain; loose; about 1 percent gravel; slightly effervescent; slightly alkaline; clear smooth boundary.

2C2—43 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; about 1 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 50 inches

Thickness of the mollic epipedon: 7 to 16 inches

Thickness of the loamy mantle: 14 to 22 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam

Content of rock fragments—0 to 8 percent gravel

Bt horizon:

Hue—10YR

Value—3 to 5

Chroma—3 or 4

Texture—sandy loam, coarse sandy loam, fine sandy loam, or loam

Content of rock fragments—0 to 8 percent gravel

2Bt horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—loamy sand or loamy coarse sand

Content of rock fragments—0 to 15 percent gravel

2Bw horizon:

Hue—10YR, 7.5YR, or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—loamy sand, loamy coarse sand, sand, or coarse sand

Content of rock fragments—0 to 15 percent gravel

2C horizon:

Hue—10YR or 2.5Y

Value—4 to 7

Chroma—2 to 4

Texture—sand or coarse sand

Content of rock fragments—0 to 15 percent gravel

567A—Verndale sandy loam, 0 to 2 percent slopes

Composition

Verndale and similar soils: About 95 percent

Inclusions: About 5 percent

Setting

Landform: Flats on pitted outwash plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 5.3 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Abbeylake and similar soils
- Almora and similar soils
- Oylen and similar soils
- Pinelake and similar soils
- Areas that have slopes of more than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

567B—Verndale sandy loam, 2 to 6 percent slopes**Composition**

Verndale and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.8 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Abbeylake and similar soils
- Almora and similar soils
- Oylen and similar soils
- Pinelake and similar soils
- Areas that have slopes of more than 6 percent or less than 2 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1131B—Verndale-Abbeylake complex, 1 to 6 percent slopes**Composition**

Verndale and similar soils: About 60 percent
Abbeylake and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Pitted outwash plains
Position on the landform: Summits and backslopes
Slope range: 1 to 6 percent

Component Description**Verndale**

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.5 inches
Organic matter content: Moderate

Abbeylake

Texture of the surface layer: Loamy sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.9 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Oylen and similar soils
- Pinelake and similar soils

- Forada and similar soils
- Nidaros and similar soils
- Areas that have slopes of more than 6 percent or less than 1 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

W—Water

General Description

- Naturally occurring basins of surface water

1356—Water, miscellaneous

Composition

Water: 95 percent

Inclusions: About 5 percent

General Description

- Small manmade areas that are used for industrial, sanitary, or mining applications and that contain water most of the year

Inclusions

- Dike banks

Waukon Series

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 35 percent

Taxonomic classification: Fine-loamy, mixed Mollic
Eutroboralfs

Typical Pedon

Waukon loam, 6 to 12 percent slopes, eroded, 2,400 feet west and 2,420 feet south of the northeast corner of sec. 27, T. 131 N., R. 38 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2)

loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; common medium and fine roots; about 3 percent gravel; neutral; abrupt smooth boundary.

Bt1—8 to 17 inches; brown (10YR 4/3) clay loam; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots; common continuous faint dark brown (10YR 3/3) clay films on faces of peds; common discontinuous faint very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 3 percent gravel; neutral; clear wavy boundary.

Bt2—17 to 27 inches; brown (10YR 4/3) clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few fine roots; many discontinuous faint very dark grayish brown (10YR 3/2) clay films on faces of peds; common discontinuous distinct very dark brown (10YR 2/2) organic coatings in root channels; about 3 percent gravel; neutral; gradual wavy boundary.

Bk—27 to 34 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; firm; few fine roots; few patchy prominent very dark brown (10YR 2/2) organic coatings in root channels; many fine irregular carbonate threads; few fine rounded iron-manganese concretions; about 3 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; firm; few fine irregular light gray (10YR 7/2) carbonate threads; few fine rounded soft masses of iron; about 3 percent gravel; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches

Content of rock fragments: 2 to 8 percent throughout

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—loam

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—loam or clay loam

Bk horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—loam or clay loam

C horizon:

Hue—10YR or 2.5Y

Value—5 or 6

Chroma—3 or 4

Texture—loam or clay loam

38B—Waukon loam, 2 to 6 percent slopes

Composition

Waukon and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Summits and backslopes

Slope range: 2 to 6 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Gonvick and similar soils
- Quam and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 6 percent
- Soils in which carbonates are closer to the surface than in the Waukon soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

38C2—Waukon loam, 6 to 12 percent slopes, eroded

Composition

Waukon and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 6 to 12 percent

Component Description

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Gonvick and similar soils
- Areas that have stones on the surface
- Cathro and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent
- Soils in which carbonates are closer to the surface than in the Waukon soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

38D2—Waukon loam, 12 to 20 percent slopes, eroded

Composition

Waukon and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 12 to 20 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Gonvick and similar soils
- Areas that have stones on the surface
- Cathro and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent
- Soils in which carbonates are closer to the surface than in the Waukon soil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

- Forest Land section

38E—Waukon loam, 20 to 30 percent slopes

Composition

Waukon and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 20 to 30 percent

Component Description

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Quam and similar soils
- Cathro and similar soils
- Areas that have slopes of less than 20 percent
- Areas that have stones on the surface
- Soils in which carbonates are closer to the surface than in the Waukon soil

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1104B—Waukon-Dorset complex, 1 to 6 percent slopes

Composition

Waukon and similar soils: About 55 percent
 Dorset and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 6 percent

Component Description

Waukon

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: High

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.0 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Peever and similar soils
- Corliss and similar soils
- Almora and similar soils
- Parnell and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1104C—Waukon-Dorset complex, 6 to 12 percent slopes, eroded

Composition

Waukon and similar soils: About 55 percent
 Dorset and similar soils: About 35 percent
 Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Backslopes and shoulders
Slope range: 6 to 12 percent

Component Description

Waukon

Texture of the surface layer: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches
Organic matter content: High

Dorset

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches
Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Peever and similar soils

- Corliss and similar soils
- Almora and similar soils
- Parnell and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1104D—Waukon-Dorset complex, 12 to 20 percent slopes, eroded

Composition

Waukon and similar soils: About 50 percent
Dorset and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 12 to 20 percent

Component Description

Waukon

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: High

Dorset

Texture of the surface layer: Sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glacial outwash

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 3.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Gonvick and similar soils
- Peever and similar soils
- Corliss and similar soils
- Almora and similar soils
- Parnell and similar soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1217E—Waukon-Lida complex, 20 to 35 percent slopes

Composition

Waukon and similar soils: About 50 percent
Lida and similar soils: About 35 percent
Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: 20 to 35 percent

Component Description

Waukon

Texture of the surface layer: Loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.6 inches

Organic matter content: High

Lida

Texture of the surface layer: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.4 inches
Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Parnell and similar soils
- Cathro and similar soils
- Two Inlets and similar soils
- Areas that have stones on the surface
- Areas that have slopes of less than 20 percent

Major Uses of the Unit

- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Weetown Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Colluvium over till
Slope range: 1 to 3 percent
Taxonomic classification: Fine-loamy, mixed Pachic Udic Argiborolls

Typical Pedon

Weetown fine sandy loam, in an area of Friberg-Weetown complex, 250 feet west and 550 feet north of the southeast corner of sec. 32, T. 134 N., R. 42 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) fine sandy loam, very dark grayish brown (10YR 3/2)

dry; weak fine and medium subangular blocky structure; friable; common fine and medium roots; about 1 percent gravel; neutral; abrupt smooth boundary.

A—9 to 27 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; common fine and medium roots; about 1 percent gravel; neutral; clear wavy boundary.

BE—27 to 31 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; common fine and medium roots; about 2 percent gravel; neutral; gradual wavy boundary.

Bt1—31 to 41 inches; dark yellowish brown (10YR 4/4) loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common fine distinct yellowish brown (10YR 5/6) Fe concentrations; common very fine and fine roots; common fine distinct dark grayish brown (10YR 4/2) clay films on faces of peds and in pores; about 3 percent gravel; slightly acid; clear wavy boundary.

Bt2—41 to 51 inches; dark brown (10YR 3/3) loam; moderate medium subangular blocky structure; friable; common medium distinct yellowish brown (10YR 5/6) Fe concentrations and common fine prominent grayish brown (2.5Y 5/2) Fe depletions; common fine faint very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few fine and medium soft masses of iron oxide; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bk—51 to 60 inches; olive brown (2.5Y 4/4) fine sandy loam; weak medium subangular blocky structure; friable; common fine and medium distinct grayish brown (2.5Y 5/2) Fe depletions and few medium prominent yellowish brown (10YR 5/6) Fe concentrations; about 5 percent gravel; common fine and medium light gray (10YR 7/2) carbonate threads; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 25 to more than 60 inches

Thickness of the mollic epipedon: 16 to 48 inches

Content of rock fragments: 1 to 10 percent throughout

Ap or A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—sandy loam, fine sandy loam, loam, or silt loam

Bt horizon:

Hue—10YR or 2.5Y
 Value—3 to 5
 Chroma—3 or 4
 Texture—sandy clay loam, sandy loam, fine sandy loam, or loam

Bk horizon:

Hue—10YR or 2.5Y
 Value—4 to 6
 Chroma—2 to 6
 Texture—sandy loam, fine sandy loam, or loam

Winger Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Upper part—moderate; lower part—moderately slow or moderate
Landforms: Lake plains and moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, frigid Typic Calciaquolls

Typical Pedon

Winger silt loam, 2,000 feet east and 200 feet north of the southwest corner of sec. 7, T. 132 N., R. 44 W.

Ap—0 to 10 inches; black (N 2/0) silt loam, very dark gray (N 3/0) dry; weak fine and medium angular blocky structure; friable; many very fine and fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ak—10 to 16 inches; very dark gray (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine and medium angular blocky structure; friable; common very fine and fine roots; many very fine and fine light gray (10YR 7/2) carbonate threads; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkg1—16 to 21 inches; gray (5Y 5/1) silty clay loam; weak fine and medium angular blocky structure; firm; common very fine and fine roots; few fine carbonate threads; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—21 to 29 inches; gray (5Y 5/1) silty clay loam; weak fine and medium angular blocky structure; firm; few very fine and fine roots; strongly effervescent; moderately alkaline; clear wavy boundary.

2Cgy—29 to 60 inches; pale olive (5Y 6/3) clay loam; massive; firm; common very fine and fine prominent dark yellowish brown (10YR 4/6) Fe

concentrations; common very fine and fine light gray (10YR 7/2) carbonate threads; common fine and medium nests of gypsum; about 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At or near the surface
Thickness of the mollic epipedon: 8 to 24 inches
Depth to glacial till: 24 to 40 inches

Ap horizon:

Hue—10YR to 5Y or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—silt loam

Ak horizon:

Hue—10YR to 5Y or neutral
 Value—2 or 3
 Chroma—0 or 1
 Texture—silt loam or silty clay loam

Bkg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 or 2
 Texture—silt loam, silty clay loam, or loam

Cg horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 to 3
 Texture—silt loam or silty clay loam

2Cgy horizon:

Hue—2.5Y or 5Y
 Value—4 to 6
 Chroma—1 to 3
 Texture—loam or clay loam
 Content of rock fragments—2 to 10 percent

107—Winger silt loam**Composition**

Winger and similar soils: About 90 percent
 Inclusions: About 10 percent

Setting

Landforms: Flats and swales on lake plains and moraines
Slope range: 0 to 1 percent

Component Description

Texture of the surface layer: Silt loam
Depth class: Very deep (more than 60 inches)

Drainage class: Poorly drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet

Available water capacity to 60 inches or root-limiting layer: About 11.8 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Quam and similar soils
- McIntosh and similar soils
- Soils in which carbonates have been leached to the subsoil
- Soils that have a loamy surface layer and subsoil

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wolverton Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderately rapid; next part—rapid; lower part—moderately slow

Landform: Lake plains

Parent material: Glaciolacustrine deposits over till

Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed Aquic Calciborolls

Typical Pedon

Wolverton very fine sandy loam, 2,375 feet west and 1,250 feet north of the southeast corner of sec. 31, T. 133 N., R. 44 W.

Ap—0 to 8 inches; black (10YR 2/1) very fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; few fine and very fine roots; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—8 to 16 inches; very dark gray (10YR 3/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak

fine and medium subangular blocky structure; friable; few fine and very fine roots; many very fine soft masses of carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk1—16 to 27 inches; olive brown (2.5Y 4/2) very fine sandy loam; weak fine and medium subangular blocky structure; friable; common fine and very fine roots; common fine irregular carbonate threads; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—27 to 34 inches; olive brown (2.5Y 4/3) very fine sandy loam; weak fine and medium subangular blocky structure; very friable; common fine distinct light yellowish brown (2.5Y 6/3) Fe concentrations; common fine irregular carbonate threads; violently effervescent; moderately alkaline; clear smooth boundary.

2Bkgy—34 to 45 inches; grayish brown (2.5Y 5/2) clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; common fine and medium prominent dark yellowish brown (10YR 4/6) Fe concentrations; many fine and medium irregular nests of gypsum; common fine irregular carbonate threads; common fine rounded soft masses of iron manganese; about 2 percent gravel; violently effervescent; moderately alkaline; clear smooth boundary.

2Cg—45 to 80 inches; grayish brown (2.5Y 5/2) clay loam; weak medium prismatic soil fragments; firm; many fine and medium prominent dark yellowish brown (10YR 4/6) Fe concentrations; common medium irregular nests of gypsum; common fine rounded soft masses of iron manganese; about 2 percent gravel; slightly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface

Thickness of the mollic epipedon: 7 to 16 inches

Depth to fine-loamy glacial till: 20 to 40 inches

Content of rock fragments: Generally none in the upper part; 1 to 10 percent in the underlying glacial till

Ap or Ak horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y

Value—3 to 6

Chroma—1 to 4

Texture—loamy very fine sand, loamy fine sand,

loamy sand, very fine sandy loam, fine sandy loam, or sandy loam

2C horizon:

Hue—2.5Y

Value—5 or 6

Chroma—1 to 4

Texture—clay loam, silty clay loam, or loam

Content of rock fragments—1 to 10 percent

1322—Wolverton very fine sandy loam

Composition

Wolverton and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 2 percent

Component Description

Texture of the surface layer: Very fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Glaciolacustrine deposits over till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 7.4 inches

Organic matter content: Moderate

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamerly and similar soils
- Doran and similar soils
- Mustinka and similar soils
- Rockwell and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wykeham Series

Depth class: Very deep

Drainage class: Moderately well drained

Permeability: Upper part—moderate or moderately rapid; lower part—moderate

Landform: Moraines

Parent material: Till

Slope range: 1 to 5 percent

Taxonomic classification: Fine-loamy, mixed Aquic Eutroboralfs

Typical Pedon

Wykeham fine sandy loam, 2,000 feet north and 2,200 feet east of the southwest corner of sec. 12, T. 131 N., R. 36 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; common very fine and fine roots; about 2 percent gravel; slightly acid; abrupt smooth boundary.

B/E—8 to 14 inches; sandy loam, about 90 percent dark yellowish brown (10YR 4/4) (Bt) and 10 percent brown (10YR 5/3) (E); weak medium subangular blocky structure; very friable; few very fine and fine roots; about 2 percent gravel; neutral; clear smooth boundary.

Bt1—14 to 21 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few very fine and fine roots; common faint dark brown (10YR 3/3) clay films on faces of peds; few fine distinct grayish brown (10YR 5/2) Fe depletions and common fine distinct yellowish brown (10YR 5/8) Fe concentrations; about 2 percent gravel; neutral; clear smooth boundary.

Bt2—21 to 28 inches; dark yellowish brown (10YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few very fine and fine roots; common distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; common medium prominent grayish brown (2.5Y 5/2) Fe depletions and common medium distinct yellowish brown (10YR 5/8) Fe concentrations; about 2 percent gravel; neutral; clear smooth boundary.

BC—28 to 31 inches; yellowish brown (10YR 5/4) sandy loam; weak thick platy structure; friable; few very fine and fine roots; common prominent grayish brown (2.5Y 5/2) clay films in pores;

common fine distinct yellowish brown (10YR 5/8) Fe concentrations; few light gray (10YR 7/2) carbonate threads; about 5 percent gravel; neutral; clear smooth boundary.

C—31 to 60 inches; light olive brown (2.5Y 5/4) sandy loam; massive; weak thick platy soil aggregates; friable; few fine prominent yellowish red (5YR 5/8) Fe concentrations; common light gray (10YR 7/2) carbonate threads; about 5 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 50 inches

A or Ap horizon:

Hue—10YR

Value—2 or 3

Chroma—1 to 2

Texture—fine sandy loam

Content of rock fragments—2 to 15 percent

E horizon:

Hue—10YR

Value—4 or 5

Chroma—2 to 4

Texture—sandy loam, fine sandy loam, loamy fine sand, or loamy sand

Content of rock fragments—2 to 15 percent

EB, E/B, B/E, or BE horizon (if it occurs):

Colors—similar to those of the E and Bt horizons

Textures—similar to those of the E and Bt horizons

Bt horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 8

Texture—sandy loam, fine sandy loam, sandy clay loam, or loam

Content of rock fragments—2 to 20 percent

C horizon:

Hue—10YR or 2.5Y

Value—4 or 5

Chroma—3 to 6

Texture—sandy loam or fine sandy loam

Content of rock fragments—2 to 20 percent

121—Wykeham fine sandy loam

Composition

Wykeham and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Moraines

Position on the landform: Foothslopes and toeslopes

Slope range: 1 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained

Dominant parent material: Till

Flooding: None

Depth to the water table: 2.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Egglake and similar soils
- Bluffton and similar soils
- Cathro and similar soils
- Snellman and similar soils
- Soils that formed in outwash
- Areas that have stones on the surface

Major Uses of the Unit

- Cropland
- Hayland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Wyndmere Series

Depth class: Very deep

Drainage class: Somewhat poorly drained

Permeability: Moderately rapid

Landform: Lake plains

Parent material: Glaciolacustrine deposits

Slope range: 0 to 3 percent

Taxonomic classification: Coarse-loamy, frigid Aeric Calciaquolls

Typical Pedon

Wyndmere fine sandy loam, 1,900 feet east and 2,500 feet north of the southwest corner of sec. 29, T. 131 N., R. 44 W.

Ap—0 to 12 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; very friable; common fine and very fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Abk—12 to 16 inches; very dark gray (10YR 3/1) fine sandy loam, dark grayish brown (2.5Y 4/2) dry; weak coarse subangular blocky structure; very friable; common fine and very fine roots; many prominent light brownish gray (2.5Y 6/2) carbonate coatings on faces of peds; violently effervescent; strongly alkaline; gradual wavy boundary.

Bk1—16 to 27 inches; olive brown (2.5Y 4/3) fine sandy loam; weak medium subangular blocky structure; very friable; few fine and very fine roots; few fine prominent gray (5Y 5/1) Fe depletions and few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; common distinct light gray (2.5Y 7/2) carbonate coatings; violently effervescent; strongly alkaline; gradual wavy boundary.

Bk2—27 to 38 inches; olive gray (5Y 5/2) fine sandy loam; weak medium subangular blocky structure; very friable; few very fine roots; many distinct white (5Y 8/1) carbonate coatings on faces of peds; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1—38 to 42 inches; light olive brown (2.5Y 5/4) fine sand; single grain; loose; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; strongly effervescent; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; grayish brown (2.5Y 5/2) fine sand; single grain; loose; few fine distinct light olive brown (2.5Y 5/6) Fe concentrations; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At or near the surface

Thickness of the mollic epipedon: 7 to 16 inches

Content of rock fragments: Typically none throughout

A horizon:

Hue—10YR

Value—2 or 3

Chroma—1 or 2

Texture—fine sandy loam

Bk horizon:

Hue—10YR to 5Y

Value—3 to 6

Chroma—1 to 3

Texture—fine sandy loam or sandy loam

C horizon:

Hue—10YR to 5Y

Value—4 to 7

Chroma—2 to 4

Texture—silt loam, fine sandy loam, loamy fine sand, or fine sand

508—Wyndmere fine sandy loam

Composition

Wyndmere and similar soils: About 90 percent

Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on lake plains

Slope range: 0 to 3 percent

Component Description

Texture of the surface layer: Fine sandy loam

Depth class: Very deep (more than 60 inches)

Drainage class: Somewhat poorly drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: 1.5 to 3.5 feet

Available water capacity to 60 inches or root-limiting layer: About 7.9 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Borup and similar soils
- Wolverton and similar soils
- Soils that have carbonates in the substratum
- Very poorly drained soils
- Cathro and similar soils

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Zell Series*Depth class:* Very deep*Drainage class:* Well drained*Permeability:* Moderate*Landform:* Moraines*Parent material:* Glaciolacustrine deposits*Slope range:* 2 to 20 percent*Taxonomic classification:* Coarse-silty, mixed Udic
Calciborolls**Typical Pedon**

Zell silt loam, in an area of Zell-Rothsay complex, 6 to 12 percent slopes, eroded, 225 feet west and 150 feet north of the southeast corner of sec. 28, T. 134 N., R. 44 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; many fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—8 to 18 inches; light yellowish brown (2.5Y 6/4) silt loam; weak medium subangular blocky structure; friable; few fine roots; few distinct light gray (2.5Y 7/2) carbonate coatings on faces of peds; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—18 to 31 inches; light yellowish brown (2.5Y 6/4) silt loam; weak medium subangular blocky structure; friable; few very fine roots; few fine prominent yellowish brown (10YR 5/6) relict Fe concentrations; few distinct light gray (2.5Y 7/2) carbonate coatings on faces of peds; violently effervescent; moderately alkaline; clear smooth boundary.

C—31 to 60 inches; light olive brown (2.5Y 5/4) silt loam; common medium prominent yellowish brown (10YR 5/6) relict Fe concentrations; weak medium platy soil fragments; friable; strongly effervescent; moderately alkaline.

Range in Characteristics*Carbonates:* At or near the surface*Thickness of the mollic epipedon:* 7 to 16 inches*Content of rock fragments:* Typically none throughout*A horizon:*

Hue—10YR

Value—2 or 3

Chroma—1

Texture—silt loam

Bk horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—silt loam, loam, or very fine sandy loam

C horizon:

Hue—10YR or 2.5Y

Value—4 to 6

Chroma—2 to 4

Texture—silt loam, loam, or very fine sandy loam

969C2—Zell-Rothsay complex, 6 to 12 percent slopes, eroded**Composition**

Zell and similar soils: About 50 percent

Rothsay and similar soils: About 35 percent

Inclusions: About 15 percent

Setting*Landform:* Moraines*Position on the landform:* Backslopes and shoulders*Slope range:* 6 to 12 percent**Component Description****Zell***Texture of the surface layer:* Silt loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Glaciolacustrine deposits*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 10.7 inches*Organic matter content:* Moderate**Rothsay***Texture of the surface layer:* Silt loam*Depth class:* Very deep (more than 60 inches)*Drainage class:* Well drained*Dominant parent material:* Glaciolacustrine deposits*Flooding:* None*Depth to the water table:* Greater than 6.0 feet*Available water capacity to 60 inches or root-limiting layer:* About 12.7 inches*Organic matter content:* High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils

- Quam and similar soils
- Lakepark and similar soils
- Areas that have slopes of more than 12 percent or less than 6 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

969D2—Zell-Rothsay complex, 12 to 20 percent slopes, eroded

Composition

Zell and similar soils: About 60 percent

Rothsay and similar soils: About 25 percent

Inclusions: About 15 percent

Setting

Landform: Moraines

Position on the landform: Backslopes and shoulders

Slope range: Zell—12 to 20 percent; Rothsay—12 to 18 percent

Component Description

Zell

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 10.7 inches

Organic matter content: Moderate

Rothsay

Texture of the surface layer: Silt loam

Depth class: Very deep (more than 60 inches)

Drainage class: Well drained

Dominant parent material: Glaciolacustrine deposits

Flooding: None

Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 12.6 inches

Organic matter content: High

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hantho and similar soils
- Quam and similar soils
- Lakepark and similar soils
- Cathro and similar soils
- Areas that have slopes of more than 20 percent or less than 12 percent

Major Uses of the Unit

- Cropland
- Hayland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

References

- American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 volumes.
- American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.
- Anderson, Curtis A. 1976. Pleistocene geology of the Comstock-Sebeka area, west-central Minnesota. Unpublished master's thesis, University of North Dakota.
- Clayton, Lee, and J.A. Cherry. 1967. Pleistocene superglacial and ice-walled lakes of west-central North America. *In* North Dakota Geologic Survey, Miscellaneous Series 30B, pages 47-52.
- Durgan, B.R., J.L. Gunsolus, and R.L. Becker. 1995. Cultural and chemical weed control in field crops. Minnesota Extension Service, Educational Development System Bulletin 3157-S.
- Elson, J.A. 1967. Geology of Glacial Lake Agassiz. *In* Life, Land, and Water, W.J. Mayer-Oaks, editor. Pages 37-96.
- Goldstein, Barry S. 1985. Stratigraphy, sedimentology, and late-Quaternary history of the Wadena drumlin region, central Minnesota. Ph.D. thesis, University of Minnesota.
- Heinselman, M.L., editor. 1974. Original vegetation of Minnesota. U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station.
- Hobbs, Howard C., and Joseph E. Goebel. 1982. Geologic map of Minnesota Quaternary geology. Minnesota Geological Survey, University of Minnesota. Wall map.
- Jenny, Hans. 1941. Factors of soil formation.
- Mason, John W. 1916. Mason's history: History of Otter Tail County, Minnesota. Volume 1, pages 297-308.
- Norton, Arthur R. 1982. Quaternary geology of the Itasca-St. Croix Moraine interlobate area, north-central Minnesota. Unpublished master's thesis, University of Minnesota.
- Otter Tail County Historical Museum. History files (taken from news and research articles).
- Sachreiter, Donald Keith. 1975. Quaternary geology of the southern part of the Grand Forks and Bemidji quadrangles. Unpublished Ph.D. dissertation, University of North Dakota, Grand Forks.

Schneider, Allan F. (No date.) Pleistocene geology of Central Minnesota. Department of Geology, State College, Pullman, Washington.

United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

United States Department of Agriculture. 1984. 1982 Minnesota national resources inventory. Soil Conservation Service.

United States Department of Agriculture. 1993. Soil survey manual. Natural Resources Conservation Service, Soil Survey Staff, U.S. Department of Agriculture Handbook 18.

United States Department of Agriculture. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys, 2nd edition. Natural Resources Conservation Service, Soil Survey Staff, U.S. Department of Agriculture Handbook 436.

United States Department of Agriculture, National Agricultural Statistics Service, and Minnesota Department of Agriculture. 1995. Minnesota agricultural statistics 1995.

United States Department of Agriculture, Natural Resources Conservation Service, and Minnesota Agricultural Extension Service. 1990. Environmental management, agricultural chemicals. Circulars 680 and 685.

University of Minnesota, Department of Soil Science. 1969. Minnesota soil atlas, Brainerd sheet. University of Minnesota, Agricultural Experiment Station Miscellaneous Report 90-1969, pages 4-9 and 11.

Wright, H.E. 1962. Role of the Wadena Lobe in the Wisconsin glaciation of Minnesota. Geological Society of America Bulletin 73: 73-100.

Wright, H.E., Jr. 1972. Quaternary history of Minnesota. *In* Geology of Minnesota: A Centennial Volume, pages 515-547.

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.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

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

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

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

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

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.

Beach deposits. Material, such as sand and gravel, that is generally laid down parallel to an active or relict shoreline of a postglacial or glacial lake.

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 the wind. A blowout has a flat or irregular floor formed by a

resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

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

Canopy. The leafy crown of trees or shrubs. (See Crown.)

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.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil material. Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay,

less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay spot (spot symbol). This symbol is used on the detailed soil maps to show areas of map unit 1077 in which the texture of the surface layer is clay or silty clay.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conservation cropping system. Growing crops in combination with needed cultural and

management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the “Soil Survey Manual.”

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

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

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

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

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

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

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Disturbed/made land (spot symbol). This symbol is used on the detailed soil maps to show areas where the natural soil has been significantly altered as a result of cutting, filling, grading, or shaping by machinery. The natural soil profile has been largely destroyed. These areas are 1/4 acre to 3 acres in size.

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 wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained*. These classes are defined in the “Soil Survey Manual.”

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

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another

within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment (spot symbol). This symbol is used on the detailed soil maps to show areas that are too steep for cultivation. These areas are $\frac{1}{4}$ acre to 4 acres in size. They are characterized by steep drops to stream channels or steep, high bank areas around glacial lakes.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper

balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the 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.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

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

Flaggy soil material. Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

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

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or

moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

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 relationship to underlying structures and of the history of geologic changes as recorded by these surface features. The term is particularly 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.

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

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock

fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Gravelly spot (spot symbol). This symbol is used on the detailed soil maps to show areas, within a nongravelly map unit, in which the content of rock fragments is 15 percent or more, by volume. These areas are $\frac{1}{4}$ acre to 3 acres in size. The symbol is not used in areas of soils that formed in glacial outwash.

Gravel pit (spot symbol). This symbol is used on the detailed soil maps to show areas of open excavations where gravelly deposits are being mined or have been mined. These areas are $\frac{1}{4}$ acre to 3 acres in size.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

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

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

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

High rise (spot symbol). This symbol is used on the detailed soil maps to show areas of better drained mineral soils within areas of organic soils or within areas of open water. The areas of better drained mineral soils are $\frac{1}{4}$ acre to 3 acres in size.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to

the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

- O horizon.*—An organic layer of fresh and decaying plant residue.
- A horizon.*—The mineral horizon at or near the surface in which an accumulation of 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 potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not

considered but are separate factors in predicting runoff.

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

Interfluve. An elevated area between two drainageways that sheds water to those drainageways.

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.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Kame moraine. An end moraine that contains numerous kames. A group of kames along the front of a stagnant glacier, commonly comprising the slumped remnants of a formerly continuous outwash plain built up over the foot of rapidly wasting or stagnant ice.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

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.

Lakebed. 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 lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

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.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

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

Marsh (spot symbol). This symbol is used on the detailed soil maps to show areas of very poorly drained soils that support marsh vegetation. Most of these areas are not cropped. They support cattails and have some open water. The areas are 1/4 acre to 3 acres in size.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment

for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

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

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an

adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nose slope. A geomorphic component of hills consisting of the projecting end (laterally convex area) of a hillside. The overland waterflow is predominantly divergent.

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. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

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

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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 or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

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

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

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

Pitted outwash plain. An outwash plain marked by many irregular depressions, such as kettles, shallow pits, and potholes, which formed by melting of incorporated ice masses. Common in Wisconsin and Minnesota.

Pitting (in tables). Pits caused by melting around ice. They form on the soil after plant cover is removed.

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.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

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

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.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sandy spot (spot symbol). This symbol is used on the detailed soil maps to show areas in which loamy sand or sand is exposed at the surface. These areas are 1/4 acre to 3 acres in size. The symbol is not used in areas of soils that formed in glacial outwash.

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.

Short, steep slope (spot symbol). This symbol is used on the detailed soil maps to show elongated soil areas that have slopes at least two slope classes steeper than those of the surrounding map units. These areas are 1/4 acre to 3 acres in size.

Shoulder. The position that forms the uppermost inclined surface near the top of a hillslope. It is a transition 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.

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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 material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Spring (spot symbol). This symbol is used on the detailed soil maps to show seepy or springlike areas on side slopes. These areas most commonly support hydrophytic vegetation and are not cultivated. They are less than 3 acres in size.

Stagnation moraine. A body of drift released by the melting of a glacier that ceased flowing. Commonly (but not always) occurs near ice margins. Composed of till, ice-contact stratified drift, and small areas of glacial lake sediment. Typical landforms include knob-and-kettle topography, locally including ice-walled lake plains.

Stone line. A concentration of coarse 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 soil blowing 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 soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

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

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

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 caused by 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. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Till. 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 soils underlain by glacial till.

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

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are

constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland. 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.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

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.

Wet spot (spot symbol). This symbol is used on the detailed soil maps to show areas of very poorly drained soils that do not support cattails and that can be cropped in some years. These areas are $\frac{1}{4}$ acre to 3 acres in size.

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

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at <http://offices.sc.egov.usda.gov/locator/app>.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.