

**USDA** United States  
Department of  
Agriculture

Natural  
Resources  
Conservation  
Service

In cooperation with  
Minnesota Agricultural  
Experiment Station

# Soil Survey of Aitkin County, Minnesota

## Part II



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# How to Use This Soil Survey

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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** in Part II shows which table has data on a specific land use for each detailed soil map unit. See the **Contents** in Part I and Part II for other sections of this publication that may address your specific needs.

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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 1993. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Aitkin Soil and Water Conservation District. Partial funding was provided by the Legislative Commission on Minnesota Resources and by Aitkin 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.

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**Cover:** An area of the Cushing-Mahtomedi general soil map unit. This unit is on rolling moraines and outwash plains and is characterized by scattered wetlands. Forest land is one of the major uses.

*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

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<b>How to Use This Soil Survey</b> .....	3		
<b>Index to Map Units</b> .....	6		
Tables:			
Classification of the Soils .....	10		
Acreage and Proportionate Extent of the Soils .....	12		
<b>Agronomy</b> .....	15		
Cropland Management Considerations .....	15		
Crop Yield Estimates .....	17		
Land Capability Classification .....	18		
Prime Farmland .....	18		
Erosion Factors .....	19		
Windbreaks and Environmental Plantings .....	20		
Tables:			
Cropland Management Considerations .....	22		
Land Capability and Yields per Acre of Crops and Pasture .....	37		
Prime Farmland .....	45		
Windbreaks and Environmental Plantings .....	46		
Windbreak Suitability Groups .....	54		
<b>Forest Land</b> .....	59		
Tables:			
Forest Land Harvest Equipment Considerations .....	61		
Forest Haul Road Considerations .....	67		
Forest Log Landing Considerations .....	73		
Forest Land Site Preparation and Planting Considerations .....	79		
<b>Recreation</b> .....	85		
		Table:	
		Recreational Development .....	87
		<b>Wildlife Habitat</b> .....	97
		Table:	
		Wildlife Habitat .....	99
		<b>Engineering</b> .....	107
		Building Site Development .....	107
		Sanitary Facilities .....	108
		Waste Management .....	109
		Construction Materials .....	110
		Water Management .....	111
		Tables:	
		Building Site Development .....	113
		Sanitary Facilities .....	123
		Construction Materials .....	134
		Water Management .....	143
		<b>Soil Properties</b> .....	157
		Engineering Index Properties .....	157
		Physical and Chemical Properties .....	158
		Water Features .....	160
		Soil Features .....	161
		Tables:	
		Engineering Index Properties .....	162
		Physical Properties of the Soils .....	188
		Chemical Properties of the Soils .....	200
		Water Features .....	211
		Soil Features .....	216
		<b>References</b> .....	221
		<b>Glossary</b> .....	223

Issued 1999

# Index to Map Units

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- 72—Shooker very fine sandy loam
- 119C—Pomroy loamy fine sand, 6 to 12 percent slopes
- 124—Brickton silt loam
- 133B—Dalbo very fine sandy loam, 1 to 6 percent slopes
- 142—Nokay fine sandy loam
- 144B—Flak sandy loam, 3 to 8 percent slopes
- 144C—Flak sandy loam, 8 to 15 percent slopes
- 146B—Wabedo sandy loam, 1 to 6 percent slopes
- 147—Spoonier silt loam
- 152B—Milaca fine sandy loam, 3 to 8 percent slopes
- 152C—Milaca fine sandy loam, 8 to 15 percent slopes
- 152E—Milaca fine sandy loam, 15 to 25 percent slopes
- 164B—Mora fine sandy loam, 1 to 4 percent slopes
- 166—Ronneby loam
- 167B—Baudette silt loam, 1 to 5 percent slopes
- 186—Nemadji loamy fine sand
- 188B—Omega loamy fine sand, 2 to 6 percent slopes
- 188C—Omega loamy fine sand, 6 to 12 percent slopes
- 188E—Omega loamy sand, 12 to 25 percent slopes
- 202—Meehan loamy sand
- 204B—Branstad loam, 2 to 6 percent slopes
- 204C—Cushing loam, 6 to 12 percent slopes
- 204E—Cushing loam, 12 to 25 percent slopes
- 218—Watab fine sand
- 240B—Warba very fine sandy loam, 1 to 6 percent slopes
- 240C—Warba very fine sandy loam, 6 to 12 percent slopes
- 243—Stuntz very fine sandy loam
- 266—Freer silt loam
- 268B—Cromwell fine sandy loam, 1 to 6 percent slopes
- 268C—Cromwell sandy loam, 6 to 12 percent slopes
- 268E—Cromwell fine sandy loam, 12 to 25 percent slopes
- 268F—Cromwell fine sandy loam, 25 to 40 percent slopes
- 292—Alstad loam
- 302B—Rosholt fine sandy loam, 2 to 6 percent slopes
- 302C—Rosholt fine sandy loam, 6 to 12 percent slopes
- 346—Talmoon fine sandy loam
- 428—Hassman muck
- 454B—Mahtomedi loamy coarse sand, 2 to 6 percent slopes
- 454C—Mahtomedi loamy coarse sand, 6 to 12 percent slopes
- 454E—Mahtomedi loamy coarse sand, 12 to 25 percent slopes
- 454F—Mahtomedi gravelly loamy sand, 25 to 40 percent slopes
- 458B—Menahga loamy sand, 1 to 6 percent slopes
- 458C—Menahga loamy sand, 6 to 12 percent slopes
- 458E—Menahga loamy sand, 12 to 25 percent slopes
- 464B—Brennyville silt loam, 2 to 5 percent slopes
- 469B—Hillcity silt loam, 1 to 6 percent slopes
- 502—Dusler silt loam
- 504B—Duluth fine sandy loam, 1 to 6 percent slopes
- 504C—Duluth fine sandy loam, 6 to 12 percent slopes
- 504E—Duluth fine sandy loam, 12 to 25 percent slopes
- 531—Beseman muck
- 532—Sago muck
- 533—Loxley peat
- 540—Seelyeville muck
- 541—Rifle peat
- 543—Markey muck
- 544—Cathro muck
- 546—Lupton muck
- 549—Greenwood peat
- 563—Northwood muck
- 564—Friendship loamy sand
- 607—Pengilly silt loam
- 615—Cowhorn loamy very fine sand
- 617B—Goodland silt loam, 1 to 10 percent slopes
- 618B—Itasca silt loam, 1 to 6 percent slopes
- 621—Morph very fine sandy loam
- 625—Sandwick loamy sand
- 627—Tawas muck
- 628—Talmoon muck, depressional
- 629B—Wawina loamy very fine sand, 1 to 10 percent slopes
- 672—Willossippi loam

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- 685—Oesterle fine sandy loam  
732B—Bushville loamy fine sand, 1 to 6 percent slopes  
734—Cormant loamy fine sand, stratified substratum  
736—Ronneby-Mora complex  
738B—Milaca-Millward complex, 2 to 8 percent slopes  
738C—Milaca-Millward complex, 8 to 15 percent slopes  
759—Waukenabo fine sandy loam  
795—Redby loamy fine sand, stratified substratum  
797—Mooselake and Lupton mucky peats  
798—Sago and Roscommon soils  
799—Seelyville-Bowstring association  
869—Lobo and Waskish peats  
870B—Itasca-Goodland complex, 2 to 6 percent slopes  
870C—Itasca-Goodland complex, 6 to 12 percent slopes  
870E—Itasca-Goodland complex, 12 to 25 percent slopes  
872—Pengilly-Winterfield association  
928C—Cushing-Mahtomedi complex, 2 to 10 percent slopes  
928D—Cushing-Mahtomedi complex, 10 to 25 percent slopes  
928F—Cushing-Mahtomedi complex, 25 to 40 percent slopes  
980—Blackhoof and Mahtowa soils  
990—Twig and Giese soils  
1002—Borosaprists and Fluvaquents, frequently flooded  
1030—Pits, gravel-Udipsamments complex  
1031—Histosols, ponded  
1072—Udorthents, shallow (sanitary landfill)  
1115—Newson loamy sand  
1150—Jevne fine sandy loam  
1154—Sax muck  
1353B—Cutaway loamy fine sand, 1 to 6 percent slopes  
1354A—Aftad fine sandy loam, 0 to 3 percent slopes  
1356—Water, miscellaneous  
1372—Wealthwood loamy fine sand  
1375B—Alban fine sandy loam, 3 to 8 percent slopes  
1878—Hamre muck  
1982—Baudette-Spooner complex  
1983—Cathro muck, stratified substratum  
1984—Leafriver muck  
W—Water

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# Soil Survey of Aitkin County, Minnesota

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

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

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

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

Soils are rated in their natural state. No unusual

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

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

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

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

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

## Classification of the Soils

Soil name	Family or higher taxonomic class
Aftad-----	Oxyaquic Glossoboralfs, coarse-loamy, mixed
Alban-----	Typic Glossoboralfs, coarse-loamy, mixed
Alstad-----	Glossaquic Eutroboralfs, fine-loamy, mixed
Baudette-----	Aquic Eutroboralfs, fine-silty, mixed
Beseman-----	Terric Borosaprists, loamy, mixed, dysic
Blackhoof-----	Histic Humaquepts, fine-loamy, mixed, nonacid, frigid
Borosaprists-----	Borosaprists
Bowstring-----	Fluvaquentic Borosaprists, euic
Branstad-----	Oxyaquic Eutroboralfs, fine-loamy, mixed
Brennyville-----	Glossaquic Eutroboralfs, coarse-loamy, mixed
Brickton-----	Vertic Epiaqualfs, fine, montmorillonitic, frigid
Bushville-----	Aquic Arenic Eutroboralfs, loamy, mixed
Cathro-----	Terric Borosaprists, loamy, mixed, euic
Cormant-----	Mollic Psammaquents, mixed, frigid
Cowhorn-----	Aeric Endoaquepts, coarse-loamy, mixed, nonacid, frigid
Cromwell-----	Typic Dystrochrepts, sandy, mixed, frigid
Cushing-----	Glossic Eutroboralfs, fine-loamy, mixed
Cutaway-----	Arenic Eutroboralfs, loamy, mixed
Dalbo-----	Vertic Eutroboralfs, fine, montmorillonitic
Duluth-----	Glossic Eutroboralfs, fine-loamy, mixed
Dusler-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Flak-----	Typic Eutroboralfs, coarse-loamy, mixed
Fluvaquents-----	Fluvaquents, loamy
Freer-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Friendship-----	Typic Udipsamments, mixed, frigid
Giese-----	Mollic Epiaquepts, coarse-loamy, mixed, frigid
Goodland-----	Glossic Eutroboralfs, coarse-loamy, mixed
Greenwood-----	Typic Borohemists, dysic
Hamre-----	Histic Humaquepts, fine-loamy, mixed, nonacid, frigid
Hassman-----	Vertic Endoaquepts, fine, montmorillonitic, nonacid, frigid
Hillcity-----	Oxyaquic Eutroboralfs, coarse-silty, mixed
Histosols-----	Histosols
Itasca-----	Glossic Eutroboralfs, coarse-loamy, mixed
Jevne-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Leafriver-----	Histic Humaquepts, sandy, mixed, frigid
Lobo-----	Hemic Sphagnofibrists, dysic, frigid
Loxley-----	Typic Borosaprists, dysic
Lupton-----	Typic Borosaprists, euic
Mahtomedi-----	Typic Udipsamments, mixed, frigid
Mahtowa-----	Typic Endoaquolls, fine-loamy, mixed, frigid
Markey-----	Terric Borosaprists, sandy or sandy-skeletal, mixed, euic
Meehan-----	Aquic Udipsamments, mixed, frigid
Menahga-----	Typic Udipsamments, mixed, frigid
Milaca-----	Typic Eutroboralfs, coarse-loamy, mixed
Millward-----	Typic Eutroboralfs, coarse-loamy, mixed
Mooselake-----	Typic Borohemists, euic
Mora-----	Aquic Eutroboralfs, coarse-loamy, mixed
Morph-----	Typic Glossaqualfs, fine-loamy, mixed, frigid
Nemadji-----	Aquentic Haplorthods, sandy, mixed, frigid
Newson-----	Humaqueptic Psammaquents, mixed, frigid
Nokay-----	Udollic Epiaqualfs, coarse-loamy, mixed, frigid
Northwood-----	Histic Humaquepts, sandy over loamy, mixed, nonacid, frigid
Oesterle-----	Aquic Glossoboralfs, coarse-loamy, mixed
Omega-----	Typic Haplorthods, sandy, mixed, frigid
Pengilly-----	Typic Fluvaquents, coarse-loamy, mixed, nonacid, frigid
Pomroy-----	Arenic Eutroboralfs, loamy, mixed
Redby-----	Aquic Udipsamments, mixed, frigid
Rifle-----	Typic Borohemists, euic
Ronneby-----	Udollic Epiaqualfs, coarse-loamy, mixed, frigid
Roscommon-----	Mollic Psammaquents, mixed, frigid
Rosholt-----	Typic Glossoboralfs, coarse-loamy, mixed
Sago-----	Histic Humaquepts, coarse-loamy, mixed, nonacid, frigid
Sandwick-----	Arenic Glossaqualfs, loamy, mixed, frigid
Sax-----	Histic Humaquepts, fine-silty, mixed, nonacid, frigid

## Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Seelyeville-----	Typic Borosaprists, euic
Shooker-----	Typic Endoaqualfs, fine-loamy, mixed, frigid
Spooner-----	Mollic Endoaqualfs, fine-silty, mixed, frigid
Stuntz-----	Aeric Glossaqualfs, fine-loamy, mixed, frigid
Talmoon-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Tawas-----	Terric Borosaprists, sandy or sandy-skeletal, mixed, euic
Twig-----	Histic Humaquepts, coarse-loamy, mixed, acid, frigid
Udipsamments-----	Udipsamments
Udorthents-----	Udorthents
Wabedo-----	Aquic Dystric Eutrochrepts, coarse-loamy, mixed, frigid
Warba-----	Glossic Eutroboralfs, fine-loamy, mixed
Waskish-----	Typic Sphagnofibrists, dysic, frigid
Watab-----	Arenic Epiaqualfs, loamy, mixed, frigid
Waukenabo-----	Mollic Endoaqualfs, coarse-loamy, mixed, frigid
Wawina-----	Typic Dystrichrepts, coarse-loamy, mixed, frigid
Wealthwood-----	Arenic Epiaqualfs, loamy, mixed, frigid
Willossippi-----	Mollic Endoaqualfs, fine-loamy, mixed, frigid
Winterfield-----	Aquic Udipsamments, mixed, frigid

## Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
72	Shooker very fine sandy loam-----	18	*
119C	Pomroy loamy fine sand, 6 to 12 percent slopes-----	783	*
124	Brickton silt loam-----	10,988	0.9
133B	Dalbo very fine sandy loam, 1 to 6 percent slopes-----	943	*
142	Nokay fine sandy loam-----	610	*
144B	Flak sandy loam, 3 to 8 percent slopes-----	806	*
144C	Flak sandy loam, 8 to 15 percent slopes-----	167	*
146B	Wabedo sandy loam, 1 to 6 percent slopes-----	1,369	0.1
147	Spooner silt loam-----	9,945	0.8
152B	Milaca fine sandy loam, 3 to 8 percent slopes-----	21,647	1.7
152C	Milaca fine sandy loam, 8 to 15 percent slopes-----	6,031	0.5
152E	Milaca fine sandy loam, 15 to 25 percent slopes-----	2,469	0.2
164B	Mora fine sandy loam, 1 to 4 percent slopes-----	46,327	3.6
166	Ronneby loam-----	32,699	2.6
167B	Baudette silt loam, 1 to 5 percent slopes-----	933	*
186	Nemadji loamy fine sand-----	6,289	0.5
188B	Omega loamy fine sand, 2 to 6 percent slopes-----	5,996	0.5
188C	Omega loamy fine sand, 6 to 12 percent slopes-----	2,049	0.2
188E	Omega loamy sand, 12 to 25 percent slopes-----	573	*
202	Meehan loamy sand-----	12,895	1.0
204B	Branstad loam, 2 to 6 percent slopes-----	16,882	1.3
204C	Cushing loam, 6 to 12 percent slopes-----	7,174	0.6
204E	Cushing loam, 12 to 25 percent slopes-----	3,433	0.3
218	Watab fine sand-----	5,574	0.4
240B	Warba very fine sandy loam, 1 to 6 percent slopes-----	4,391	0.3
240C	Warba very fine sandy loam, 6 to 12 percent slopes-----	1,478	0.1
243	Stuntz very fine sandy loam-----	6,846	0.5
266	Freer silt loam-----	4,933	0.4
268B	Cromwell fine sandy loam, 1 to 6 percent slopes-----	4,404	0.3
268C	Cromwell sandy loam, 6 to 12 percent slopes-----	6,845	0.5
268E	Cromwell fine sandy loam, 12 to 25 percent slopes-----	5,204	0.4
268F	Cromwell fine sandy loam, 25 to 40 percent slopes-----	1,552	0.1
292	Alstad loam-----	23,150	1.8
302B	Rosholt fine sandy loam, 2 to 6 percent slopes-----	8,273	0.6
302C	Rosholt fine sandy loam, 6 to 12 percent slopes-----	2,082	0.2
346	Talmoon fine sandy loam-----	10,608	0.8
428	Hassman muck-----	4,725	0.4
454B	Mahtomedi loamy coarse sand, 2 to 6 percent slopes-----	4,718	0.4
454C	Mahtomedi loamy coarse sand, 6 to 12 percent slopes-----	4,262	0.3
454E	Mahtomedi loamy coarse sand, 12 to 25 percent slopes-----	3,055	0.2
454F	Mahtomedi gravelly loamy sand, 25 to 40 percent slopes-----	2,398	0.2
458B	Menahga loamy sand, 1 to 6 percent slopes-----	7,061	0.6
458C	Menahga loamy sand, 6 to 12 percent slopes-----	3,055	0.2
458E	Menahga loamy sand, 12 to 25 percent slopes-----	1,712	0.1
464B	Brennyville silt loam, 2 to 5 percent slopes-----	6,057	0.5
469B	Hillcity silt loam, 1 to 6 percent slopes-----	1,238	*
502	Dusler silt loam-----	28,477	2.2
504B	Duluth fine sandy loam, 1 to 6 percent slopes-----	26,077	2.0
504C	Duluth fine sandy loam, 6 to 12 percent slopes-----	11,623	0.9
504E	Duluth fine sandy loam, 12 to 25 percent slopes-----	3,598	0.3
531	Beseman muck-----	7,008	0.5
532	Sago muck-----	16,412	1.3
533	Loxley peat-----	34,924	2.7
540	Seelyville muck-----	50,807	4.0
541	Rifle peat-----	54,683	4.3
543	Markey muck-----	23,760	1.9
544	Cathro muck-----	71,243	5.6
546	Lupton muck-----	102,158	8.0
549	Greenwood peat-----	76,233	6.0
563	Northwood muck-----	2,496	0.2
564	Friendship loamy sand-----	6,605	0.5
607	Pengilly silt loam-----	8,608	0.7

See footnote at end of table.

## Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
615	Cowhorn loamy very fine sand-----	11,133	0.9
617B	Goodland silt loam, 1 to 10 percent slopes-----	421	*
618B	Itasca silt loam, 1 to 6 percent slopes-----	1,315	0.1
621	Morph very fine sandy loam-----	21	*
625	Sandwick loamy sand-----	22,895	1.8
627	Tawas muck-----	31	*
628	Talmoon muck, depressional-----	12,075	0.9
629B	Wawina loamy very fine sand, 1 to 10 percent slopes-----	6,110	0.5
672	Willossippi loam-----	10,815	0.8
685	Oesterle fine sandy loam-----	12,260	1.0
732B	Bushville loamy fine sand, 1 to 6 percent slopes-----	6,957	0.5
734	Cormant loamy fine sand, stratified substratum-----	3,379	0.3
736	Ronneby-Mora complex-----	13,196	1.0
738B	Milaca-Millward complex, 2 to 8 percent slopes-----	5,897	0.5
738C	Milaca-Millward complex, 8 to 15 percent slopes-----	1,650	0.1
759	Waukenabo fine sandy loam-----	7,652	0.6
795	Redby loamy fine sand, stratified substratum-----	1,748	0.1
797	Mooselake and Lupton mucky peats-----	481	*
798	Sago and Roscommon soils-----	27	*
799	Seelyeville-Bowstring association-----	83	*
869	Lobo and Waskish peats-----	2,569	0.2
870B	Itasca-Goodland complex, 2 to 6 percent slopes-----	3,682	0.3
870C	Itasca-Goodland complex, 6 to 12 percent slopes-----	7,237	0.6
870E	Itasca-Goodland complex, 12 to 25 percent slopes-----	3,900	0.3
872	Pengilly-Winterfield association-----	1,874	0.1
928C	Cushing-Mahtomedi complex, 2 to 10 percent slopes-----	16,573	1.3
928D	Cushing-Mahtomedi complex, 10 to 25 percent slopes-----	14,552	1.1
928F	Cushing-Mahtomedi complex, 25 to 40 percent slopes-----	1,963	0.2
980	Blackhoof and Mahtowa soils-----	7,793	0.6
990	Twig and Giese soils-----	15,678	1.2
1002	Borosaprists and Fluvaquents, frequently flooded-----	18,478	1.4
1030	Pits, gravel-Udipsamments complex-----	850	*
1031	Histosols, ponded-----	11,523	0.9
1072	Udorthents, shallow (sanitary landfill)-----	35	*
1115	Newson loamy sand-----	8,142	0.6
1150	Jevne fine sandy loam-----	10,013	0.8
1154	Sax muck-----	7,627	0.6
1353B	Cutaway loamy fine sand, 1 to 6 percent slopes-----	9,142	0.7
1354A	Aftad fine sandy loam, 0 to 3 percent slopes-----	879	*
1356	Water, miscellaneous-----	30	*
1372	Wealthwood loamy fine sand-----	1,877	0.1
1375B	Alban fine sandy loam, 3 to 8 percent slopes-----	382	*
1878	Hamre muck-----	11,858	0.9
1982	Baudette-Spooner complex-----	10,155	0.8
1983	Cathro muck, stratified substratum-----	30,254	2.4
1984	Leafriver muck-----	8,794	0.7
W	Water-----	113,470	8.9
	Total-----	1,276,800	100.0

\* Less than 0.1 percent.

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# Agronomy

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

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

## Cropland Management Considerations

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Management Considerations." The main management concerns for the land user are water management, erosion control, weed and brush control, maintenance of adequate fertility levels, and crop variety selection. Good soil management involves all of these factors.

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

Additional considerations are as follows:

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

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

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

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

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

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

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

Additional information about species and varieties can be obtained from local offices of the Cooperative Extension Service or the Natural Resources Conservation Service.

## Explanation of Criteria

*Acid soil.*—The pH is less than 6.1.

*Channeled.*—The word "channeled" is included in the map unit name.

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

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

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

*Flooding.*—Flooding is occasional or frequent.

*Gullied.*—The word "gullied" is included in the map unit name.

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

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

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

*Limited organic matter content.*—The content of

organic matter is 2 percent or less in the surface layer.

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

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

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

*Potential for surface-water contamination (by nutrients or pesticides).*—The map unit component is occasionally flooded or frequently flooded, is subject to ponding, is assigned to hydrologic group C or D and has a slope of more than 2 percent, is assigned to hydrologic group A and has a slope of more than 6 percent, or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

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

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

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

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

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

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

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

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

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

The natural fertility of the soils in the county ranges from medium to very low. Reaction of the surface soil commonly ranges from pH 5.1 to 6.5. Applications of lime are necessary to correct excess acidity. Some soils may require as much as 5 tons of lime per acre. Applying liming materials is expensive because of the high cost of shipping over long distances. Alternative lime sources are available, however, such as spent lime from wastewater

treatment plants. State and local regulations may have guidelines for applying alternative lime sources.

Many soils in the county are naturally wet. Poor drainage can delay planting and harvesting. Wetness and low soil temperature in the spring can retard early plant growth. Because the normal growing season is short, cool, and moist, early maturing varieties of crops should be selected. In areas of very poorly drained soils, such as Blackhoof, Hamre, Hassman, Leafriver, Giese, Sago, Sax, Talmoon, and Twig soils, agronomic crop production is not feasible unless an adequate drainage system is installed. In most years, crops grown on poorly drained soils, such as Brickton, Spooner, Waukenabo, and Willosippi soils, will be damaged by wetness.

Open drainage ditches are more common than subsurface drains, but both are effective if properly installed. Proper design and installation of a drainage system include consideration of the type of soil being drained. Locating suitable drainage outlets is difficult because of the low relief throughout much of the county. Because of recent Federal and State wetland protection regulations, it may be necessary to check with county and State agencies for permits when any drainage project is being considered.

Soil erosion by water and wind is a management concern on all cultivated cropland in the county. Failure to adequately control erosion results in the sedimentation of streams, lakes, and drainage systems and reduces productivity of the land. Water erosion is a concern in areas of Cushing, Cromwell, Duluth, Hillcity, and Milaca soils and on all soils that have slopes of more than 10 percent. Wind erosion is a concern in areas of Cutaway, Menahga, Omega, Pomroy, and Wawina soils. Using a conservation cropping system that includes a sod-forming forage crop at least 3 consecutive years in a 5-year rotation helps to keep soil losses within tolerable limits. On pasture and hayland, measures that keep the forage in good condition and prevent overgrazing are effective in controlling erosion.

Controlling weeds and brush eliminates or reduces competition from undesirable species. Timely cultivation during seedbed preparation normally is effective in minimizing early weed growth, but the timely, selective use of chemicals during the cropping season may be necessary for optimum crop yields. The effectiveness of some soil-applied herbicides for weed control is reduced in areas of soils that have a thick organic surface layer.

The major brush species that should be controlled are alder, willow, and prickly ash. Alder and willow commonly grow in open pastures, and prickly ash is common in wooded pastures. Young alder and willow

plants may be mechanically controlled with a sickle mower. As the plants mature, a rotary brush mower or chemical control may be necessary. In areas that are accessible to mechanical equipment, prickly ash can be controlled by mowing. In other areas, chemical control may be needed.

Plant species selected for hayland or pasture should be based on the soil type, drainage class, and pH. Alfalfa requires adequate drainage and a pH of 6.5 or higher. Red clover and birdsfoot trefoil can withstand wetter conditions and a somewhat lower pH. Well drained and moderately well drained soils, such as Baudette, Cushing, Duluth, Goodland, Itasca, Milaca, and Warba soils, are suited to the widest range of species, including alfalfa, birdsfoot trefoil, red clover, timothy, smooth brome grass, Kentucky bluegrass, orchardgrass, and reed canarygrass. Applications of lime may be necessary if alfalfa is grown on any of these soils, except for the Baudette and Warba soils. The substratum of these soils contains lime that allows for satisfactory growth of alfalfa after establishment.

Somewhat poorly drained to very poorly drained soils, including Alstad, Cowhorn, Dusler, Hamre, Hassman, Nemadji, Ronneby, Sago, Spooner, and Stuntz soils, are suited only to species that can withstand wet soil conditions. Unless adequate drainage is provided, these soils are too wet for the production of high-quality legumes. Suitable species include creeping foxtail, redtop, reed canarygrass, alsike clover, birdsfoot trefoil, and ladino clover. If drained, these soils are suitable for Kentucky bluegrass, orchardgrass, red clover, smooth brome grass, and timothy.

Well drained to excessively drained soils, such as Cromwell, Mahtomedi, Menahga, and Pomroy soils, generally produce forage in spring and early summer. Warmer summer temperatures result in droughty conditions that limit production. Alfalfa, birdsfoot trefoil, Kentucky bluegrass, orchardgrass, red clover, and smooth brome grass grow well if adequate moisture is available. These soils are suited to warm-season grasses, such as big bluestem, little bluestem, indiagrass, sideoats grama, and switchgrass. If properly managed, these warm-season species will provide forage during the summer. Combined with cool-season species, they help to provide a full season of grazing.

Proper seed placement and good seed-to-soil contact help to establish grasses and legumes. In areas where erosion is a serious hazard, no-till or minimum till equipment can be used to reestablish hayland and pasture. Spring rains, inadequate drainage systems, and poorly drained soils can make

spring establishment of forage crops somewhat difficult. Many farmers have had success with planting forage crops in early August.

Good forage management includes determining, through soil testing, the proper amount of lime and the proper amount and kind of fertilizer; timely cutting or grazing, depending on the forage species; controlling weeds; using proper stocking rates; and applying measures that allow adequate regrowth prior to freezing weather.

## Crop Yield Estimates

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

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

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

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

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

## Pasture and Hayland Interpretations

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

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

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

## Land Capability Classification

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

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

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

If properly managed, soils in classes 1, 2, 3, and 4 are suitable for the mechanized production of commonly grown field crops and for pasture and woodland. The degree of the soil limitations affecting

the production of cultivated crops increases progressively from class 1 to class 4. The limitations can affect levels of production and the risk of permanent soil deterioration caused by erosion and other factors.

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

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

*Capability subclasses* identify the dominant kind of limitation in the class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 2*e*. The letter *e* shows that the main hazard is the risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class 1 because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, woodland, wildlife habitat, or recreation.

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

## Prime Farmland

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

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic

production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. An adequate moisture supply and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources, and farming these soils results in the least damage to the environment.

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

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

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

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

About 225,000 acres, or nearly 18 percent of the survey area, meets the requirements for prime farmland.

The map units in the survey area that meet the requirements for prime farmland are listed in the table "Prime Farmland." This list does not constitute a recommendation for a particular land use. On some

soils included in the table, measures that overcome limitations are needed. The need for these measures is indicated in parentheses after the map unit name. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section "Soil Series and Detailed Soil Map Units" in Part I of this survey.

## Erosion Factors

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

### Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

### Fragment-Free Soil Erodibility (Kf) Factor

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

### Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields,

maintenance of water-control structures affected by sedimentation, prevention of gulying, and the value of nutrients lost through erosion.

## Wind Erodibility Groups

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

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

## Windbreaks and Environmental Plantings

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

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

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

Windbreaks are often planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil. Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

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

## Windbreak Suitability Groups

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

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

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

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

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

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

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

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

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

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

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

*Group 5* consists of soils that are excessively drained to moderately well drained and have a moderate available water capacity. These soils are dominantly fine sandy loam or sandy loam, but some

are sandy in the upper part and loamy in the lower part.

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

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

*Group 7* consists of excessively drained to well drained soils that are dominantly loamy fine sand or coarser textured and are shallow to sand or to sand and gravel. These soils have a low available water capacity.

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

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

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

## Cropland Management Considerations

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

Soil name and map symbol	Cropland management considerations
72: Shooker-----	Potential for ground-water contamination Water table Wind erosion
119C: Pomroy-----	Dense layer Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
124: Brickton-----	Potential for ground-water contamination Water table
133B: Dalbo-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
142: Nokay-----	Acid soil Dense layer Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water table Wind erosion
144B: Flak-----	Dense layer Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
144C: Flak-----	Dense layer Limited available water capacity Limited organic matter content Potential for surface-water contamination Restricted permeability Water erosion Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
146B: Wabedo-----	Acid soil Dense layer Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Water table Wind erosion
147: Spooner-----	Potential for ground-water contamination Water table
152B: Milaca-----	Dense layer Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
152C: Milaca-----	Dense layer Limited available water capacity Limited organic matter content Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
152E: Milaca-----	Dense layer Limited available water capacity Limited organic matter content Potential for surface-water contamination Restricted permeability Slope Water erosion Wind erosion
164B: Mora-----	Dense layer Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Water table Wind erosion
166: Ronneby-----	Dense layer Potential for ground-water contamination Restricted permeability Water table
167B: Baudette-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
186: Nemadji-----	Acid soil Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
188B: Omega-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
188C: Omega-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
188E: Omega-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
202: Meehan-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
204B: Branstad-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
204C: Cushing-----	Potential for surface-water contamination Water erosion
204E: Cushing-----	Potential for surface-water contamination Slope Water erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
218: Watab-----	Acid soil Dense layer Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Restricted permeability Water table Wind erosion
240B: Warba-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
240C: Warba-----	Potential for surface-water contamination Water erosion Wind erosion
243: Stuntz-----	Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
266: Freer-----	Acid soil Dense layer Limited organic matter content Potential for ground-water contamination Restricted permeability Water table
268B: Cromwell-----	Acid soil Excessive permeability Limited organic matter content Potential for ground-water contamination Water erosion Wind erosion
268C: Cromwell-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
268E: Cromwell-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
268F: Cromwell-----	Acid soil Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
292: Alstad-----	Potential for ground-water contamination Potential for surface-water contamination Water table
302B: Rosholt-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
302C: Rosholt-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
346: Talmoon-----	Potential for ground-water contamination Water table Wind erosion
428: Hassman-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
454B: Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
454C: Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
454E: Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
454F: Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion
458B: Menahga-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
458C: Menahga-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
458E: Menahga-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
464B: Brennyville-----	Acid soil Dense layer Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Water table
469B: Hillcity-----	Potential for ground-water contamination Potential for surface-water contamination Water erosion
502: Dusler-----	Acid soil Potential for ground-water contamination Water table

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
504B: Duluth-----	Acid soil Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
504C: Duluth-----	Acid soil Limited organic matter content Potential for surface-water contamination Water erosion Wind erosion
504E: Duluth-----	Acid soil Limited organic matter content Potential for surface-water contamination Slope Water erosion Wind erosion
531: Beseman-----	Acid soil High organic matter content Ponding Potential for ground-water contamination Wind erosion
532: Sago-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
533: Loxley-----	Acid soil Excessive permeability High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination
540: Seelyeville-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
541: Rifle-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination
543: Markey-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
544: Cathro-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
546: Lupton-----	High organic matter content Potential for ground-water contamination Water table Wind erosion
549: Greenwood-----	Acid soil Excessive permeability High organic matter content Potential for ground-water contamination Water table
563: Northwood-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination Wind erosion
564: Friendship-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
607: Pengilly-----	Flooding Potential for ground-water contamination Potential for surface-water contamination Water table
615: Cowhorn-----	Limited organic matter content Potential for ground-water contamination Water table Wind erosion
617B: Goodland-----	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion
618B: Itasca-----	Acid soil Potential for surface-water contamination Water erosion
621: Morph-----	Potential for ground-water contamination Water table Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
625: Sandwick-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Water table Wind erosion
627: Tawas-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Wind erosion
628: Talmoon-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
629B: Wawina-----	Limited organic matter content Potential for surface-water contamination Wind erosion
672: Willossippi-----	Potential for ground-water contamination Water table
685: Oesterle-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
732B: Bushville-----	Dense layer Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water table Wind erosion
734: Cormant-----	Excessive permeability Potential for ground-water contamination Water table Wind erosion
736: Ronneby-----	Dense layer Potential for ground-water contamination Restricted permeability Water table Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
736: Mora-----	Dense layer Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Water table Wind erosion
738B: Milaca-----	Dense layer Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
Millward-----	Excessive permeability Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
738C: Milaca-----	Dense layer Limited available water capacity Limited organic matter content Potential for surface-water contamination Restricted permeability Water erosion Wind erosion
Millward-----	Excessive permeability Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
759: Waukenabo-----	Potential for ground-water contamination Water table Wind erosion
795: Redby-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Water table Wind erosion
797: Mooselake-----	High organic matter content Ponding Potential for ground-water contamination
Lupton-----	High organic matter content Potential for ground-water contamination Water table

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
798:	
Sago-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
Roscommon-----	Excessive permeability Limited available water capacity Ponding Potential for ground-water contamination Potential for surface-water contamination Wind erosion
799:	
Seelyville-----	Flooding High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Wind erosion
Bowstring-----	Flooding High organic matter content Potential for ground-water contamination Potential for surface-water contamination
869:	
Lobo-----	Acid soil Excessive permeability High organic matter content Potential for ground-water contamination Water table
Waskish-----	Acid soil Excessive permeability High organic matter content Potential for ground-water contamination Water table
870B:	
Itasca-----	Acid soil Potential for surface-water contamination Water erosion
Goodland-----	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion
870C:	
Itasca-----	Acid soil Potential for surface-water contamination Water erosion
Goodland-----	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
870E: Itasca-----	Acid soil Potential for surface-water contamination Slope Water erosion
Goodland-----	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion
872: Pengilly-----	Flooding Potential for ground-water contamination Potential for surface-water contamination Water table
Winterfield-----	Excessive permeability Flooding Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
928C: Cushing-----	Limited organic matter content Potential for surface-water contamination Water erosion Wind erosion
Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Wind erosion
928D: Cushing-----	Potential for surface-water contamination Slope Water erosion
Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
928F: Cushing-----	Limited organic matter content Potential for surface-water contamination Slope Water erosion Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
928F: Mahtomedi-----	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
980: Blackhoof-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
Mahtowa-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
990: Twig-----	Acid soil Dense layer High organic matter content Ponding Potential for ground-water contamination Restricted permeability Wind erosion
Giese-----	Acid soil Dense layer High organic matter content Ponding Potential for ground-water contamination Restricted permeability Wind erosion
1002: Borosaprist-----	Flooding High organic matter content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Fluvaquents-----	Flooding Potential for ground-water contamination Potential for surface-water contamination Water table
1030: Pits-----	Nonsoil material
Udipsamments-----	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Slope Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
1031: Histosols-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination
1072: Udorthents.	
1115: Newson-----	Acid soil Excessive permeability Limited available water capacity Ponding Potential for ground-water contamination Potential for surface-water contamination Wind erosion
1150: Jevne-----	Potential for ground-water contamination Water table Wind erosion
1154: Sax-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
1353B: Cutaway-----	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Wind erosion
1354A: Aftad-----	Potential for ground-water contamination Wind erosion
1372: Wealthwood-----	Acid soil Excessive permeability Potential for ground-water contamination Water table Wind erosion
1375B: Alban-----	Limited organic matter content Potential for surface-water contamination Water erosion Wind erosion
1878: Hamre-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion

## Cropland Management Considerations--Continued

Soil name and map symbol	Cropland management considerations
1982:	
Baudette-----	Potential for ground-water contamination
Spooner-----	Potential for ground-water contamination Water table
1983:	
Cathro-----	High organic matter content Ponding Potential for ground-water contamination Wind erosion
1984:	
Leafriver-----	Excessive permeability High organic matter content Ponding Potential for ground-water contamination Wind erosion

Land Capability and Yields per Acre of Crops and Pasture

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

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats		Corn silage	
		Tons		Tons		Tons		Tons		Tons		Bu		Tons	
72: Shooker-----	4w	3.0		2.5		2.0		5.0		3.2		40.0			
119C: Pomroy-----	4s	2.7		2.4		2.3		---		3.2		40.0		8.0	
124: Brickton-----	2w	4.0		3.2		3.2		6.5		4.7		60.0			
133B: Dalbo-----	2e	4.2		3.6		3.7		6.5		4.9		65.0			
142: Nokay-----	2w	---		3.4		3.2		6.0		4.3		45.0			
144B: Flak-----	2e	3.5		2.9		2.7		5.0		4.0		45.0			
144C: Flak-----	3e	3.0		2.5		2.3		4.3		3.6		40.0			
146B: Wabedo-----	2e	3.5		2.9		2.7		5.0		4.0		50.0			
147: Spoonier-----	4w	4.0		3.6		3.4		6.5		5.2		60.0			
152B: Milaca-----	2e	4.0		3.2		3.0		5.5		4.3		60.0		12.0	
152C: Milaca-----	3e	3.7		3.0		2.8		5.0		3.8		55.0		10.0	
152E: Milaca-----	6e	3.0		2.5		2.5		---		3.4		---		---	
164B: Mora-----	2e	3.7		3.4		3.2		6.0		4.5		50.0		13.0	
166: Ronneby-----	2w	---		3.2		3.0		6.0		4.5		50.0		12.0	

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Bu	Tons	Bu	Tons	
167B: Baudette-----	2e	4.2	3.8	3.6	6.5	5.4	60.0	---					
186: Nemadji-----	3w	2.3	2.1	2.0	4.0	3.0	35.0	---				8.0	
189B: Omega-----	4s	2.8	2.0	1.9	---	2.7	30.0	---				6.0	
188C: Omega-----	4s	2.8	2.0	1.9	---	2.7	30.0	---				6.0	
188E: Omega-----	7S	---	---	---	---	2.4	---	---				---	
202: Mechan-----	4w	2.5	2.0	1.9	4.0	2.9	35.0	---				8.0	
204B: Branstad-----	2e	4.0	3.6	3.4	6.0	4.8	60.0	---				13.0	
204C: Cushing-----	3e	3.4	3.1	2.9	5.5	4.5	55.0	---				11.0	
204E: Cushing-----	4e	2.8	2.5	2.3	---	4.0	---	---				---	
218: Watab-----	3w	---	2.1	2.0	4.7	3.2	40.0	---				9.0	
240B: Warba-----	2e	4.0	3.6	3.4	6.0	5.0	55.0	---				13.0	
240C: Warba-----	3e	3.7	3.2	3.0	5.7	4.7	50.0	---				11.0	
243: Stantz-----	2w	3.8	3.5	3.3	6.0	4.8	60.0	---				12.0	
266: Freer-----	2w	3.6	3.1	2.9	6.0	4.7	50.0	---				12.0	
268B: Cromwell-----	3e	3.3	3.0	2.8	---	4.2	45.0	---				11.0	
268C: Cromwell-----	4e	3.0	2.8	2.6	---	3.7	40.0	---				9.0	

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Tons	Bu	Tons	Tons	
268E: Cromwell-----	6e	2.5	2.4	2.3	---	---	---	---	---	---	---	---	---
268F: Cromwell-----	6e	2.5	2.4	2.3	---	---	---	---	---	---	---	---	---
292: Alstad-----	2w	4.0	3.4	3.2	5.7	60.0	12.0	---	---	---	---	---	---
302B: Rosholt-----	2e	3.7	3.2	3.0	---	---	---	---	---	---	---	---	---
302C: Rosholt-----	3e	3.5	2.9	2.7	---	---	---	---	---	---	---	---	---
346: Talmoon-----	2w	3.9	3.7	3.5	6.0	55.0	12.0	---	---	---	---	---	---
428: Hassman-----	6w	---	---	---	5.0	---	---	---	---	---	---	---	---
454B: Mahtomedi-----	4s	1.8	1.6	1.4	---	25.0	5.0	---	---	---	---	---	---
454C: Mahtomedi-----	6s	1.8	1.6	1.4	---	25.0	5.0	---	---	---	---	---	---
454E: Mahtomedi-----	6s	1.6	1.5	1.3	---	---	---	---	---	---	---	---	---
454F: Mahtomedi-----	7s	---	---	---	---	---	---	---	---	---	---	---	---
458B: Menahga-----	4s	2.0	1.8	1.7	---	30.0	6.0	---	---	---	---	---	---
458C: Menahga-----	4s	2.0	1.8	1.7	---	30.0	6.0	---	---	---	---	---	---
458E: Menahga-----	6s	1.8	1.6	1.5	---	---	---	---	---	---	---	---	---
464B: Brennyville-----	2e	4.0	3.4	3.2	5.5	55.0	13.0	---	---	---	---	---	---
469B: Hillicity-----	2e	4.3	3.9	3.6	6.8	60.0	---	---	---	---	---	---	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Tons	Bu	Tons		
502: Dusler-----	2w	3.8	3.4	3.5	6.5	5.0	60.0	12.0					
504B: Duluth-----	2e	4.0	3.6	3.5	6.2	5.0	60.0	13.0					
504C: Duluth-----	3e	3.8	3.2	3.3	6.0	4.5	55.0	10.0					
504E: Duluth-----	6e	2.8	2.5	2.3	---	4.0	---	---					
531: Beseman-----	7w	---	---	---	---	---	---	---					
532: Sago-----	6w	---	---	---	5.0	---	---	---					
533: Loxley-----	7w	---	---	---	---	---	---	---					
540: Seelyville-----	6w	---	---	---	4.5	---	---	---					
541: Rifle-----	6w	---	---	---	---	---	---	---					
543: Markey-----	6w	---	---	---	4.5	---	---	---					
544: Cathro-----	6w	---	---	---	4.5	---	---	---					
546: Lupton-----	7w	---	---	---	4.5	---	---	---					
549: Greenwood-----	7w	---	---	---	---	---	---	---					
563: Northwood-----	6w	---	---	---	5.0	---	---	---					
564: Friendship-----	4s	2.2	2.0	1.8	---	2.9	35.0	8.0					
607: Pengilly-----	7w	---	---	---	5.0	---	---	---					

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage	
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Tons	Bu	Tons	Tons		
615: Cowhorn-----	2w	3.7	3.3	3.1	5.0	4.5	45.0	---	---	---	---	---	---	
617B: Goodland-----	2e	4.0	3.6	3.4	6.0	4.9	55.0	---	---	---	---	---	---	
618B: Itasca-----	2e	4.0	3.6	3.4	6.0	4.9	55.0	---	---	---	---	---	---	
621: Morph-----	4w	---	2.5	2.0	5.0	3.2	45.0	---	---	---	---	---	---	
625: Sandwich-----	3w	---	3.0	2.8	5.0	4.1	35.0	---	---	---	---	---	---	
627: Tawas-----	6w	---	---	---	5.0	---	---	---	---	---	---	---	---	
628: Talmoon-----	6w	---	---	---	5.0	---	---	---	---	---	---	---	---	
629B: Wawina-----	2s	3.5	3.0	2.8	---	4.2	50.0	---	---	---	---	---	---	
672: Willosippi-----	4w	4.0	3.6	3.4	5.0	4.7	55.0	---	---	---	---	---	---	
685: Oesterle-----	2w	3.3	3.0	2.8	5.0	4.2	45.0	---	---	---	---	11.0	---	
732B: Bushville-----	3s	3.0	2.7	2.5	---	3.6	35.0	---	---	---	---	8.0	---	
734: Cormant-----	4w	---	2.4	2.2	5.0	3.2	35.0	---	---	---	---	---	---	
736: Ronneby-----	2w	---	3.2	3.0	6.0	4.5	50.0	---	---	---	---	12.0	---	
Mora-----	2e	---	3.4	3.2	6.0	4.5	50.0	---	---	---	---	13.0	---	
738B: Millaca-----	2e	4.0	3.2	3.0	---	4.3	60.0	---	---	---	---	12.0	---	
Millwarf-----	3e	3.0	3.2	3.0	---	4.3	40.0	---	---	---	---	12.0	---	

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Tons	Bu	Tons	Tons	
738C: Milaca-----	3e	3.7	3.0	2.8	---	---	---	---	---	3.8	55.0	10.0	
Millward-----	4e	2.8	2.8	2.6	---	---	---	---	---	3.8	30.0	10.0	
759: Waukenabo-----	4w	3.4	3.0	2.8	---	---	---	5.0	---	4.1	40.0	---	
795: Redby-----	3w	2.3	2.1	2.0	---	---	---	4.5	---	3.0	35.0	---	
797: Mooselake-----	6w	---	---	---	---	---	---	4.5	---	---	---	---	
Lupton-----	7w	---	---	---	---	---	---	4.5	---	---	---	---	
798: Sago-----	6w	---	---	---	---	---	---	5.0	---	---	---	---	
Roscommon-----	6w	---	---	---	---	---	---	5.0	---	---	---	---	
799: Seelyeville-----	6w	---	---	---	---	---	---	---	---	---	---	---	
Bowstring-----	6w	---	---	---	---	---	---	---	---	---	---	---	
869: Lobo-----	7w	---	---	---	---	---	---	---	---	---	---	---	
Waskish-----	7w	---	---	---	---	---	---	---	---	---	---	---	
870B: Itasca-----	2e	4.0	3.6	3.4	---	---	---	6.0	---	4.9	55.0	---	
Goodland-----	2e	4.0	3.6	3.4	---	---	---	6.0	---	4.9	55.0	---	
870C: Itasca-----	3e	3.5	3.1	2.9	---	---	---	5.5	---	4.5	45.0	---	
Goodland-----	3e	3.5	3.1	2.9	---	---	---	5.5	---	4.5	45.0	---	
870E: Itasca-----	6e	2.8	2.5	2.3	---	---	---	---	---	4.1	---	---	
Goodland-----	6e	2.8	2.5	2.3	---	---	---	---	---	4.1	---	---	

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats	Corn silage
		Tons	Tons	Tons	Tons	Tons	Tons	AUM*	Tons	Bu	Tons	Tons	
872: Pengilly-----	7w	---	---	---	---	---	---	5.0	---	---	---	---	---
Winterfield-----	7w	---	---	---	---	---	---	4.5	---	---	---	---	---
928C: Cushing-----	3e	3.4	3.1	2.9	---	---	---	---	4.5	---	11.0	---	---
Mahtomedi-----	6s	1.8	1.6	1.4	---	---	---	---	2.7	---	5.0	---	---
928D: Cushing-----	4e	2.8	2.5	2.3	---	---	---	---	4.0	---	---	---	---
Mahtomedi-----	6s	1.6	1.5	1.3	---	---	---	---	2.5	---	---	---	---
928F: Cushing-----	6e	---	---	---	---	---	---	---	3.0	---	---	---	---
Mahtomedi-----	7s	---	---	---	---	---	---	---	---	---	---	---	---
980: Blackhoof-----	6w	---	---	---	---	---	---	5.0	---	---	---	---	---
Mahtowa-----	5W	---	---	---	---	---	---	5.0	---	---	---	---	---
990: Twig-----	7w	---	---	---	---	---	---	5.0	---	---	---	---	---
Giese-----	6w	---	---	---	---	---	---	5.0	---	---	---	---	---
1002: Borosapristis-----	7w	---	---	---	---	---	---	---	---	---	---	---	---
Fluvaquents-----	6w	---	---	---	---	---	---	---	---	---	---	---	---
1030: Pits-----	8s	---	---	---	---	---	---	---	---	---	---	---	---
Udipsamments-----	8s	---	---	---	---	---	---	---	---	---	---	---	---
1031: Histosols-----	8w	---	---	---	---	---	---	---	---	---	---	---	---
1072: Udorthents.		---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Alfalfa hay		Orchardgrass- trefoil hay		Timothy-red clover hay		Reed canarygrass		Grass-legume hay		Oats		Corn silage	
		Tons		Tons		Tons		Tons		AUM*		Tons		Bu	
1115: Newson-----	6w	---	2.0	---	1.8	---	3.5	---	2.6	---	35.0	---	---	---	---
1150: Jevne-----	2w	3.9	3.7	---	3.5	---	6.0	---	4.7	---	55.0	---	12.0	---	
1154: Sax-----	6w	---	---	---	---	---	5.0	---	---	---	---	---	---	---	
1353B: Cutaway-----	3s	3.7	2.9	---	2.7	---	---	---	3.8	---	45.0	---	---	---	
1354A: Aftad-----	1	3.6	3.3	---	3.0	---	5.8	---	4.4	---	55.0	---	12.0	---	
1372: Wealthwood-----	4w	---	2.7	---	2.5	---	5.0	---	3.5	---	35.0	---	7.0	---	
1375B: Alban-----	2e	3.5	3.2	---	3.0	---	5.8	---	4.2	---	50.0	---	11.0	---	
1878: Hamre-----	6w	---	---	---	---	---	5.0	---	---	---	---	---	---	---	
1982: Baudette-----	1	4.2	3.8	---	3.6	---	6.5	---	5.4	---	60.0	---	---	---	
Spoooner-----	4w	4.0	3.6	---	3.4	---	6.5	---	5.2	---	60.0	---	---	---	
1983: Cathro-----	6w	---	---	---	---	---	---	---	4.5	---	---	---	---	---	
1984: Leafriver-----	6w	---	---	---	---	---	5.0	---	5.0	---	---	---	---	---	

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

## Prime Farmland

Map symbol	Soil name
124	Brickton silt loam (where drained)
133B	Dalbo very fine sandy loam, 1 to 6 percent slopes
146B	Wabedo sandy loam, 1 to 6 percent slopes
147	Spooner silt loam (where drained)
152B	Milaca fine sandy loam, 3 to 8 percent slopes
164B	Mora fine sandy loam, 1 to 4 percent slopes
166	Ronneby loam (where drained)
167B	Baudette silt loam, 1 to 5 percent slopes
204B	Branstad loam, 2 to 6 percent slopes
240B	Warba very fine sandy loam, 1 to 6 percent slopes
243	Stuntz very fine sandy loam (where drained)
266	Freer silt loam
292	Alstad loam (where drained)
464B	Brennyville silt loam, 2 to 5 percent slopes
469B	Hillcity silt loam, 1 to 6 percent slopes
502	Dusler silt loam (where drained)
504B	Duluth fine sandy loam, 1 to 6 percent slopes
615	Cowhorn loamy very fine sand (where drained)
618B	Itasca silt loam, 1 to 6 percent slopes
629B	Wawina loamy very fine sand, 1 to 10 percent slopes
736	Ronneby-Mora complex
1150	Jevne fine sandy loam (where drained)
1982	Baudette-Spooner complex (where drained)
1983	Cathro muck, stratified substratum (where drained)

## Windbreaks and Environmental Plantings

(Only the soils suitable for windbreaks and environmental plantings are listed. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
72: Shooker-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Green ash, eastern white pine, golden willow.	Silver maple.
119C: Pomroy-----	---	Amur maple, Siberian peashrub, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce, red pine.	Green ash, Norway spruce, jack pine, eastern white pine.	---
124: Brickton-----	---	Silky dogwood, redosier dogwood, common ninebark, northern whitecedar, nannyberry viburnum, American cranberrybush.	Balsam fir, white spruce.	Red maple, silver maple, white ash, green ash.	---
133B: Dalbo-----	---	Amur maple, silky dogwood, gray dogwood, lilac, northern whitecedar, American cranberrybush.	White spruce-----	Red maple, silver maple, white ash, red pine, eastern white pine.	---
142: Nokay-----	---	Siberian peashrub, blue spruce, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
144B, 144C: Flak-----	---	Amur maple, Siberian peashrub, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
146B: Wabedo-----	---	Amur maple, Siberian peashrub, gray dogwood, sargent crabapple, common chokecherry, late lilac, northern whitecedar, arrowwood, American cranberrybush.	Hackberry, eastern redcedar, Manchurian crabapple.	---	---
147: Spoooner-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Green ash, eastern white pine, golden willow.	Silver maple.
152B, 152C, 152E: Milaca-----	---	Amur maple, Siberian peashrub, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---
164B: Mora-----	---	Amur maple, Siberian peashrub, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---
166: Ronneby-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
167B: Baudette-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
186: Nemadji-----	---	Siberian peashrub, redosier dogwood, blue spruce, lilac, American cranberrybush.	Eastern redcedar, white spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
188B, 188C, 188E: Omega-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
202: Meehan-----	---	Siberian peashrub, redosier dogwood, American plum, lilac.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
204B: Branstad-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
204C, 204E: Cushing-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
218: Watab-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
240B, 240C: Warba-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
243: Stuntz-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
266: Freer-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
268B, 268C, 268E, 268F: Cromwell-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
292: Alstad-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
302B, 302C: Rosholt-----	Siberian peashrub, silver buffaloberry, lilac.	Eastern redcedar, Siberian crabapple, Manchurian crabapple.	Russian-olive, green ash, jack pine, red pine, eastern white pine.	---	---
346: Talmoon-----	---	Siberian peashrub, redosier dogwood, eastern redcedar.	Russian-olive, Siberian crabapple, white spruce, northern whitecedar.	Green ash, Norway spruce, eastern white pine, northern red oak, golden willow.	---
454B, 454C, 454E, 454F: Mahtomedi-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
458B, 458C, 458E: Menahga-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
464B: Brennyville-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
469B: Hillcity-----	---	Siberian peashrub, redosier dogwood, blue spruce, lilac.	Amur maple, eastern redcedar, Manchurian crabapple, white spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
502: Dusler-----	---	Amur maple, Siberian peashrub, common chokecherry, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, white spruce.	Green ash, jack pine, eastern white pine.	---
504B, 504C, 504E: Duluth-----	---	Amur maple, gray dogwood, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, white spruce, Black Hills spruce, nannyberry viburnum.	Green ash, jack pine, eastern white pine.	---
564: Friendship-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
615: Cowhorn-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
617B: Goodland-----	Siberian peashrub, silver buffaloberry, lilac.	Russian-olive, eastern redcedar, Siberian crabapple, Manchurian crabapple.	Green ash, jack pine, red pine, eastern white pine.	---	---
618B: Itasca-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
621: Morph-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Green ash, eastern white pine, golden willow.	Silver maple.
625: Sandwick-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
629B: Wawina-----	---	Amur maple, Siberian peashrub, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce, red pine.	Green ash, Norway spruce, jack pine, eastern white pine.	---
672: Willossippi-----	---	Siberian peashrub, redosier dogwood, eastern redcedar, Siberian crabapple.	Russian-olive, white spruce, northern whitecedar.	Green ash, Norway spruce, eastern white pine, northern red oak, golden willow.	---
685: Oesterle-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
732B: Bushville-----	---	Siberian peashrub, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce, red pine.	Green ash, Norway spruce, jack pine, eastern white pine.	---
734: Cormant-----	---	Siberian peashrub, redosier dogwood, lilac.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Green ash, eastern white pine, golden willow.	Silver maple.
736: Ronneby-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce.	Green ash, Norway spruce, jack pine, red pine, eastern white pine.	---
Mora-----	---	Amur maple, Siberian peashrub, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---
738B, 738C: Milaca-----	---	Amur maple, Siberian peashrub, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
738B, 738C: Millward-----	---	Amur maple, Siberian peashrub, Tatarian honeysuckle, lilac, northern whitecedar, American cranberrybush.	Eastern redcedar, Manchurian crabapple, white spruce.	Green ash, jack pine, eastern white pine.	---
759: Waukenabo-----	---	Siberian peashrub, redosier dogwood, American cranberrybush.	Russian-olive, white spruce, blue spruce, northern whitecedar.	Green ash, Norway spruce, eastern white pine, golden willow.	Silver maple.
795: Redby-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Russian-olive, white spruce, blue spruce.	Hackberry, green ash, Norway spruce, jack pine, red pine.	---
870B, 870C, 870E: Itasca-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
Goodland-----	Siberian peashrub, silver buffaloberry, lilac.	Russian-olive, eastern redcedar, Siberian crabapple, Manchurian crabapple.	Green ash, jack pine, red pine, eastern white pine.	---	---
928C, 928D, 928F: Cushing-----	---	Amur maple, gray dogwood, lilac, northern whitecedar, nannyberry viburnum, American cranberrybush.	Norway spruce, white spruce, Black Hills spruce.	Red maple, white ash, eastern white pine.	---
Mahtomedi-----	---	Siberian peashrub, eastern redcedar, Siberian crabapple, Manchurian crabapple, lilac.	Russian-olive, green ash, jack pine, red pine.	Eastern white pine, Siberian elm.	---
1150: Jevne-----	---	American plum, lilac, American cranberrybush.	Amur maple, Russian-olive, blue spruce, northern whitecedar.	Norway spruce, eastern white pine, golden willow, American basswood.	Silver maple.

## Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1353B: Cutaway-----	---	Amur maple, Siberian peashrub, lilac, American cranberrybush.	Eastern redcedar, white spruce, blue spruce, red pine.	Green ash, Norway spruce, jack pine, eastern white pine.	---
1354A: Aftad-----	---	Amur maple, gray dogwood, lilac, northern whitecedar, American cranberrybush.	Norway spruce, white spruce, Black Hills spruce.	Red maple, white ash, red pine, eastern white pine.	---
1372: Wealthwood-----	---	Redosier dogwood, white spruce, black spruce, chokecherry, lilac, American cranberrybush.	Green ash, tamarack, Norway spruce.	Silver maple, cottonwood, golden willow.	---
1375B: Alban-----	---	Amur maple, gray dogwood, lilac, northern whitecedar, American cranberrybush.	Norway spruce, white spruce, Black Hills spruce.	Red maple, white ash, red pine, eastern white pine.	---
1982: Baudette-----	---	Amur maple, Siberian peashrub, redosier dogwood, lilac.	Eastern redcedar, Manchurian crabapple, white spruce, blue spruce, northern whitecedar.	Green ash, red pine, eastern white pine.	---
Spooner-----	---	Siberian peashrub, redosier dogwood, lilac, American cranberrybush.	Norway spruce, white spruce, blue spruce, northern whitecedar.	Green ash, eastern white pine, golden willow.	Silver maple.

## Windbreak Suitability Groups

(See text for a description of the characteristics of the soils in each group)

Soil name and map symbol	Windbreak suitability group
72: Shooker-----	2
119C: Pomroy-----	5
124: Brickton-----	2, drained; 10, undrained
133B: Dalbo-----	4
142: Nokay-----	1
144B, 144C: Flak-----	4F
146B: Wabedo-----	4F
147: Spooner-----	2
152B, 152C, 152E: Milaca-----	4F
164B: Mora-----	4F
166: Ronneby-----	4F
167B: Baudette-----	3
186: Nemadji-----	1
188B, 188C, 188E: Omega-----	7
202: Meehan-----	1
204B: Branstad-----	3
204C, 204E: Cushing-----	3
218: Watab-----	2
240B, 240C: Warba-----	3
243: Stuntz-----	1

## Windbreak Suitability Groups--Continued

Soil name and map symbol	Windbreak suitability group
266: Freer-----	1
268B, 268C, 268E, 268F: Cromwell-----	7
292: Alstad-----	1
302B, 302C: Rosholt-----	6G
346: Talmoon-----	2
428: Hassman-----	2W, drained; 10, undrained
454B, 454C, 454E, 454F: Mahtomedi-----	7
458B, 458C, 458E: Menahga-----	7
464B: Brennyville-----	4F
469B: Hillcity-----	1
502: Dusler-----	1
504B, 504C: Duluth-----	3
504E: Duluth-----	10
532: Sago-----	2W, drained; 10, undrained
533: Loxley-----	1, drained; 10, undrained
540: Seelyeville-----	2H, drained; 10, undrained
541: Rifle-----	2H, drained; 10, undrained
543: Markey-----	2H, drained; 10, undrained
544: Cathro-----	2H, drained; 10, undrained
546: Lupton-----	2H, drained; 10, undrained

## Windbreak Suitability Groups--Continued

Soil name and map symbol	Windbreak suitability group
549: Greenwood-----	10
563: Northwood-----	2H, drained; 10, undrained
564: Friendship-----	7
607: Pengilly-----	10
615: Cowhorn-----	1
617B: Goodland-----	6G
618B: Itasca-----	3
621: Morph-----	2
625: Sandwick-----	2
627: Tawas-----	2H
628: Talmoon-----	2W, drained; 10, undrained
629B: Wawina-----	5
672: Willossippi-----	2
685: Oesterle-----	1
732B: Bushville-----	5
734: Cormant-----	2
736: Ronneby-----	4F
Mora-----	4F
738B, 738C: Milaca-----	4F
Millward-----	5
759: Waukenabo-----	2
795: Redby-----	1

## Windbreak Suitability Groups--Continued

Soil name and map symbol	Windbreak suitability group
797: Mooselake-----	2H, drained; 10, undrained
Lupton-----	2H, drained; 10, undrained
798: Sago-----	2W, drained; 10, undrained
Roscommon-----	5, drained; 2, undrained
799: Seelyeville-----	10
Bowstring-----	10
869: Lobo-----	10
Waskish-----	10
870B, 870C, 870E: Itasca-----	3
Goodland-----	6G
872: Pengilly-----	10
Winterfield-----	10
928C, 928D, 928F: Cushing-----	3
Mahtomedi-----	7
980: Blackhoof-----	2W, drained; 10, undrained
Mahtowa-----	2W, drained; 10, undrained
990: Twig-----	2W
Giese-----	2, drained
1002: Borosapristis-----	10
Fluvaquents-----	10
1030: Pits-----	10
Udipsamments-----	10
1031: Histosols-----	10
1072: Udorthents-----	10
1115: Newson-----	2, drained; 10, undrained

## Windbreak Suitability Groups--Continued

Soil name and map symbol	Windbreak suitability group
1150: Jevne-----	2
1154: Sax-----	2W, drained; 10, undrained
1353B: Cutaway-----	5
1354A: Aftad-----	3
1372: Wealthwood-----	2
1375B: Alban-----	3
1878: Hamre-----	2W, drained; 10, undrained
1982: Baudette-----	3
Sponer-----	2
1983: Cathro-----	2H, drained; 10, undrained

# Forest Land

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Information about the hazards and limitations that should be considered in areas used as forest land are given in the tables “Forest Land Harvest Equipment Considerations,” “Forest Haul Road Considerations,” “Forest Log Landing Considerations,” and “Forest Land Site Preparation and Planting Considerations.”

## Forest Land Harvest Equipment Considerations

For most soils spring is the most limiting season. Alternate thawing and freezing during snowmelt cause saturation and low strength of the surface soil layers. When thawing is complete, saturation continues for short periods in well drained soils to nearly all year in very poorly drained depressional soils. Degrees of wetness are generally proportionate to water table height and duration. The water table generally is lower in the summer during the heavy use of moisture by vegetation and is nearer the surface during periods when absorbed precipitation is greater than the vegetation requires. Harvesting during periods of saturation usually results in severe soil damage, except when the soil is frozen. The preferred season for timber harvest on many soils is winter, when wetness and low soil strength can be overcome by freezing.

Considerations shown in the table are as follows:

*Slope.*—The upper slope limit is more than 15 percent.

*Flooding.*—The map unit component is frequently flooded.

*Wetness.*—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

*Depth to hard rock.*—The depth to hard bedrock is less than 10 inches.

*Rubblly surface.*—The word “rubblly” is in the map unit name.

*Surface stones.*—The words “extremely stony” are in the map unit name.

*Surface boulders.*—The word “bouldery” is in the map unit name.

*Areas of rock outcrop.*—The words “Rock outcrop” are in the map unit name.

*Susceptible to rutting and wheel slippage (low strength).*—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

*Poor traction (loose sandy material).*—The USDA texture includes sands or loamy sands in any layer at a depth of 10 inches or less.

## Forest Haul Road Considerations

Haul roads serve as transportation routes from log landings to primary roads. Generally, haul roads are unpaved, but some are graveled.

Considerations shown in the table are as follows:

*Slope.*—The slope is 8 percent or more.

*Flooding.*—The map unit component is frequently flooded.

*Wetness.*—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

*Depth to hard rock.*—The depth to hard bedrock is less than 20 inches.

*Depth to soft rock.*—The depth to soft bedrock is less than 20 inches.

*Surface boulders.*—The word “bouldery” is in the map unit name.

*Areas of rock outcrop.*—The words “Rock outcrop” are in the map unit name.

*Low bearing strength.*—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

*Rubblly surface.*—The word “rubblly” is in the map unit name.

## Forest Log Landing Considerations

Log landings are areas where logs are assembled for transportation. Areas that require little or no cutting, filling, or surface preparation are desired.

Considerations shown in the table are as follows:

*Slope.*—The slope is more than 3 percent.

*Flooding.*—The map unit component is occasionally flooded or frequently flooded.

*Wetness.*—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

*Surface boulders.*—The word “bouldery” is in the map unit name.

*Areas of rock outcrop.*—The words “Rock outcrop” are in the map unit name.

*Susceptible to rutting and wheel slippage (low strength).*—The AASHTO classification is A-6, A-7, or A-8 in any layer at a depth of 20 inches or less.

*Rubby surface.*—The word “rubby” is in the map unit name.

## Forest Land Site Preparation and Planting Considerations

Considerations shown in this table are as follows:

*Slope.*—The upper slope limit is more than 15 percent.

*Flooding.*—The map unit component is frequently flooded.

*Wetness.*—The map unit component is somewhat poorly drained, poorly drained, or very poorly drained or has a perched water table (any drainage class).

*Depth to hard rock.*—The depth to hard bedrock is less than 20 inches.

*Surface stones.*—The word “stony” is in the map unit name.

*Surface boulders.*—The word “bouldery” is in the map unit name.

*Areas of rock outcrop.*—The words “Rock outcrop” are in the map unit name.

*Water erosion.*—The slope is 8 percent or more.

*Potential poor tilth and compaction.*—The AASHTO classification is A-6 or A-7 in the upper 10 inches.

*Rubby surface.*—The word “rubby” is in the map unit name.

*Cobbly surface.*—The word “cobbly” is in the map unit name.

## Forest Land Harvest Equipment Considerations

(Only the soils suitable for woodland are listed. See text for a description of the considerations listed in this table)

Soil name and map symbol	Forest land harvest equipment considerations
72: Shooker-----	Susceptible to rutting and wheel slippage Wetness
119C: Pomroy-----	Poor traction (loose sandy material)
124: Brickton-----	Susceptible to rutting and wheel slippage Wetness
133B: Dalbo-----	Susceptible to rutting and wheel slippage
142: Nokay-----	Wetness
144B: Flak-----	Wetness
144C: Flak-----	No major considerations or hazards
146B: Wabedo-----	Wetness
147: Spooner-----	Susceptible to rutting and wheel slippage Wetness
152B: Milaca-----	Wetness
152C: Milaca-----	No major considerations or hazards
152E: Milaca-----	Slope
164B: Mora-----	Wetness
166: Ronneby-----	Wetness
167B: Baudette-----	Susceptible to rutting and wheel slippage
186: Nemadji-----	Poor traction (loose sandy material) Wetness
188B, 188C: Omega-----	Poor traction (loose sandy material)
188E: Omega-----	Poor traction (loose sandy material) Slope

## Forest Land Harvest Equipment Considerations--Continued

Soil name and map symbol	Forest land harvest equipment considerations
202: Meehan-----	Poor traction (loose sandy material) Wetness
204B: Branstad-----	Susceptible to rutting and wheel slippage Wetness
204C: Cushing-----	No major considerations or hazards
204E: Cushing-----	Slope Susceptible to rutting and wheel slippage
218: Watab-----	Poor traction (loose sandy material) Wetness
240B: Warba-----	Susceptible to rutting and wheel slippage
240C: Warba-----	Susceptible to rutting and wheel slippage
243: Stuntz-----	Susceptible to rutting and wheel slippage Wetness
266: Freer-----	Susceptible to rutting and wheel slippage Wetness
268B, 268C: Cromwell-----	No major considerations or hazards
268E, 268F: Cromwell-----	Slope
292: Alstad-----	Susceptible to rutting and wheel slippage Wetness
302B, 302C: Rosholt-----	No major considerations or hazards
346: Talmoon-----	Susceptible to rutting and wheel slippage Wetness
428: Hassman-----	Susceptible to rutting and wheel slippage Wetness
454B, 454C: Mahtomedi-----	Poor traction (loose sandy material)
454E, 454F: Mahtomedi-----	Poor traction (loose sandy material) Slope
458B, 458C: Menahga-----	Poor traction (loose sandy material)

## Forest Land Harvest Equipment Considerations--Continued

Soil name and map symbol	Forest land harvest equipment considerations
458E: Menahga-----	Poor traction (loose sandy material) Slope
464B: Brennyville-----	Wetness
469B: Hillcity-----	No major considerations or hazards
502: Dusler-----	Wetness
504B, 504C: Duluth-----	Susceptible to rutting and wheel slippage
504E: Duluth-----	Slope Susceptible to rutting and wheel slippage
531: Beseman-----	Susceptible to rutting and wheel slippage Wetness
532: Sago-----	Susceptible to rutting and wheel slippage Wetness
533: Loxley-----	Susceptible to rutting and wheel slippage Wetness
540: Seelyeville-----	Susceptible to rutting and wheel slippage Wetness
541: Rifle-----	Susceptible to rutting and wheel slippage Wetness
543: Markey-----	Susceptible to rutting and wheel slippage Wetness
544: Cathro-----	Susceptible to rutting and wheel slippage Wetness
546: Lupton-----	Susceptible to rutting and wheel slippage Wetness
549: Greenwood-----	Susceptible to rutting and wheel slippage Wetness
564: Friendship-----	Poor traction (loose sandy material)
607: Pengilly-----	Flooding Wetness

## Forest Land Harvest Equipment Considerations--Continued

Soil name and map symbol	Forest land harvest equipment considerations
615: Cowhorn-----	Poor traction (loose sandy material) Wetness
617B: Goodland-----	No major considerations or hazards
618B: Itasca-----	No major considerations or hazards
621: Morph-----	Wetness
625: Sandwick-----	Poor traction (loose sandy material) Wetness
627: Tawas-----	Susceptible to rutting and wheel slippage Wetness
628: Talmoon-----	Susceptible to rutting and wheel slippage Wetness
629B: Wawina-----	Poor traction (loose sandy material)
672: Willossippi-----	Susceptible to rutting and wheel slippage Wetness
685: Oesterle-----	Wetness
732B: Bushville-----	Poor traction (loose sandy material) Wetness
734: Cormant-----	Poor traction (loose sandy material) Wetness
736: Ronneby-----	Wetness
Mora-----	Wetness
738B: Milaca-----	Wetness
Millward-----	No major considerations or hazards
738C: Milaca-----	No major considerations or hazards
Millward-----	No major considerations or hazards
759: Waukenabo-----	Susceptible to rutting and wheel slippage Wetness

## Forest Land Harvest Equipment Considerations--Continued

Soil name and map symbol	Forest land harvest equipment considerations
795: Redby-----	Poor traction (loose sandy material) Wetness
797: Mooselake-----	Susceptible to rutting and wheel slippage Wetness
Lupton-----	Susceptible to rutting and wheel slippage Wetness
798: Sago-----	Susceptible to rutting and wheel slippage Wetness
Roscommon-----	Poor traction (loose sandy material) Wetness
869: Lobo-----	Susceptible to rutting and wheel slippage Wetness
Waskish-----	Susceptible to rutting and wheel slippage Wetness
870B: Itasca-----	No major considerations or hazards
Goodland-----	No major considerations or hazards
870C: Itasca-----	Poor traction (loose sandy material)
Goodland-----	No major considerations or hazards
870E: Itasca-----	Poor traction (loose sandy material) Slope
Goodland-----	Slope
872: Pengilly-----	Flooding Wetness
Winterfield-----	Flooding Poor traction (loose sandy material) Wetness
928C: Cushing-----	Susceptible to rutting and wheel slippage
Mahtomedi-----	Poor traction (loose sandy material)
928D, 928F: Cushing-----	Slope Susceptible to rutting and wheel slippage
Mahtomedi-----	Poor traction (loose sandy material) Slope

## Forest Land Harvest Equipment Considerations--Continued

Soil name and map symbol	Forest land harvest equipment considerations
980: Blackhoof-----	Susceptible to rutting and wheel slippage Wetness
Mahtowa-----	Susceptible to rutting and wheel slippage Wetness
990: Twig-----	Susceptible to rutting and wheel slippage Wetness
Giese-----	Susceptible to rutting and wheel slippage Wetness
1115: Newson-----	Poor traction (loose sandy material) Wetness
1150: Jevne-----	Susceptible to rutting and wheel slippage Wetness
1154: Sax-----	Susceptible to rutting and wheel slippage Wetness
1353B: Cutaway-----	Poor traction (loose sandy material) Wetness
1354A: Aftad-----	Poor traction (loose sandy material) Wetness
1372: Wealthwood-----	Poor traction (loose sandy material) Wetness
1375B: Alban-----	No major considerations or hazards
1878: Hamre-----	Susceptible to rutting and wheel slippage Wetness
1982: Baudette-----	Susceptible to rutting and wheel slippage
Spooner-----	Susceptible to rutting and wheel slippage Wetness

## Forest Haul Road Considerations

(Only the soils suitable for woodland are listed. See text for a description of the considerations listed in this table)

Soil name and map symbol	Forest haul road considerations
72: Shooker-----	Low bearing strength Wetness
119C: Pomroy-----	Slope
124: Brickton-----	Low bearing strength Wetness
133B: Dalbo-----	Low bearing strength
142: Nokay-----	Wetness
144B: Flak-----	Slope Wetness
144C: Flak-----	Slope
146B: Wabedo-----	Wetness
147: Spooner-----	Low bearing strength Wetness
152B: Milaca-----	Slope Wetness
152C, 152E: Milaca-----	Slope
164B: Mora-----	Wetness
166: Ronneby-----	Wetness
167B: Baudette-----	Low bearing strength
186: Nemadji-----	Wetness
188B: Omega-----	No major considerations or hazards
188C, 188E: Omega-----	Slope
202: Mechan-----	Wetness

## Forest Haul Road Considerations--Continued

Soil name and map symbol	Forest haul road considerations
204B: Branstad-----	Low bearing strength Wetness
204C: Cushing-----	Slope
204E: Cushing-----	Low bearing strength Slope
218: Watab-----	Wetness
240B: Warba-----	Low bearing strength
240C: Warba-----	Low bearing strength Slope
243: Stuntz-----	Low bearing strength Wetness
266: Freer-----	Low bearing strength Wetness
268B: Cromwell-----	No major considerations or hazards
268C, 268E, 268F: Cromwell-----	Slope
292: Alstad-----	Low bearing strength Wetness
302B: Rosholt-----	No major considerations or hazards
302C: Rosholt-----	Slope
346: Talmoon-----	Low bearing strength Wetness
428: Hassman-----	Low bearing strength Wetness
454B: Mahtomedi-----	No major considerations or hazards
454C, 454E, 454F: Mahtomedi-----	Slope
458B: Menahga-----	No major considerations or hazards
458C, 458E: Menahga-----	Slope

## Forest Haul Road Considerations--Continued

Soil name and map symbol	Forest haul road considerations
464B: Brennyville-----	Wetness
469B: Hillcity-----	No major considerations or hazards
502: Dusler-----	Wetness
504B: Duluth-----	Low bearing strength
504C, 504E: Duluth-----	Low bearing strength Slope
531: Beseman-----	Low bearing strength Wetness
532: Sago-----	Low bearing strength Wetness
533: Loxley-----	Low bearing strength Wetness
540: Seelyeville-----	Low bearing strength Wetness
541: Rifle-----	Low bearing strength Wetness
543: Markey-----	Low bearing strength Wetness
544: Cathro-----	Low bearing strength Wetness
546: Lupton-----	Low bearing strength Wetness
549: Greenwood-----	Low bearing strength Wetness
564: Friendship-----	No major considerations or hazards
607: Pengilly-----	Flooding Wetness
615: Cowhorn-----	Wetness
617B: Goodland-----	Slope

## Forest Haul Road Considerations--Continued

Soil name and map symbol	Forest haul road considerations
618B: Itasca-----	No major considerations or hazards
621: Morph-----	Wetness
625: Sandwick-----	Wetness
627: Tawas-----	Low bearing strength Wetness
628: Talmoon-----	Low bearing strength Wetness
629B: Wawina-----	Slope
672: Willossippi-----	Low bearing strength Wetness
685: Oesterle-----	Wetness
732B: Bushville-----	Wetness
734: Cormant-----	Wetness
736: Ronneby-----	Wetness
Mora-----	Wetness
738B: Milaca-----	Slope Wetness
Millward-----	Slope
738C: Milaca-----	Slope
Millward-----	Slope
759: Waukenabo-----	Low bearing strength Wetness
795: Redby-----	Wetness
797: Mooselake-----	Low bearing strength Wetness
Lupton-----	Low bearing strength Wetness

## Forest Haul Road Considerations--Continued

Soil name and map symbol	Forest haul road considerations
798: Sago-----	Low bearing strength Wetness
Roscommon-----	Wetness
869: Lobo-----	Low bearing strength Wetness
Waskish-----	Low bearing strength Wetness
870B: Itasca-----	No major considerations or hazards
Goodland-----	No major considerations or hazards
870C, 870E: Itasca-----	Slope
Goodland-----	Slope
872: Pengilly-----	Flooding Wetness
Winterfield-----	Flooding Wetness
928C, 928D, 928F: Cushing-----	Low bearing strength Slope
Mahtomedi-----	Slope
980: Blackhoof-----	Low bearing strength Wetness
Mahtowa-----	Low bearing strength Wetness
990: Twig-----	Low bearing strength Wetness
Giese-----	Low bearing strength Wetness
1115: Newson-----	Wetness
1150: Jevne-----	Low bearing strength Wetness
1154: Sax-----	Low bearing strength Wetness
1353B: Cutaway-----	Wetness

## Forest Haul Road Considerations--Continued

Soil name and map symbol	Forest haul road considerations
1354A: Aftad-----	Wetness
1372: Wealthwood-----	Wetness
1375B: Alban-----	Slope
1878: Hamre-----	Low bearing strength Wetness
1982: Baudette-----	Low bearing strength
Spoooner-----	Low bearing strength Wetness

## Forest Log Landing Considerations

(Only the soils suitable for woodland are listed. See text for a description of the considerations listed in this table)

Soil name and map symbol	Forest log landing considerations
72: Shooker-----	Susceptible to rutting and wheel slippage Wetness
119C: Pomroy-----	Slope
124: Brickton-----	Susceptible to rutting and wheel slippage Wetness
133B: Dalbo-----	Slope Susceptible to rutting and wheel slippage
142: Nokay-----	Wetness
144B: Flak-----	Slope Wetness
144C: Flak-----	Slope
146B: Wabedo-----	Slope Wetness
147: Spooner-----	Susceptible to rutting and wheel slippage Wetness
152B: Milaca-----	Slope Wetness
152C, 152E: Milaca-----	Slope
164B: Mora-----	Slope Wetness
166: Ronneby-----	Wetness
167B: Baudette-----	Slope Susceptible to rutting and wheel slippage
186: Nemadji-----	Wetness
188B, 188C, 188E: Omega-----	Slope
202: Meehan-----	Wetness

## Forest Log Landing Considerations--Continued

Soil name and map symbol	Forest log landing considerations
204B: Branstad-----	Slope Susceptible to rutting and wheel slippage Wetness
204C: Cushing-----	Slope
204E: Cushing-----	Slope Susceptible to rutting and wheel slippage
218: Watab-----	Wetness
240B, 240C: Warba-----	Slope Susceptible to rutting and wheel slippage
243: Stuntz-----	Susceptible to rutting and wheel slippage Wetness
266: Freer-----	Susceptible to rutting and wheel slippage Wetness
268B, 268C, 268E, 268F: Cromwell-----	Slope
292: Alstad-----	Susceptible to rutting and wheel slippage Wetness
302B, 302C: Rosholt-----	Slope
346: Talmoon-----	Susceptible to rutting and wheel slippage Wetness
428: Hassman-----	Susceptible to rutting and wheel slippage Wetness
454B, 454C, 454E, 454F: Mahtomedi-----	Slope
458B, 458C, 458E: Menahga-----	Slope
464B: Brennyville-----	Slope Wetness
469B: Hillcity-----	Slope
502: Dusler-----	Wetness
504B, 504C, 504E: Duluth-----	Slope Susceptible to rutting and wheel slippage

## Forest Log Landing Considerations--Continued

Soil name and map symbol	Forest log landing considerations
531: Beseman-----	Susceptible to rutting and wheel slippage Wetness
532: Sago-----	Susceptible to rutting and wheel slippage Wetness
533: Loxley-----	Susceptible to rutting and wheel slippage Wetness
540: Seelyeville-----	Susceptible to rutting and wheel slippage Wetness
541: Rifle-----	Susceptible to rutting and wheel slippage Wetness
543: Markey-----	Susceptible to rutting and wheel slippage Wetness
544: Cathro-----	Susceptible to rutting and wheel slippage Wetness
546: Lupton-----	Susceptible to rutting and wheel slippage Wetness
549: Greenwood-----	Susceptible to rutting and wheel slippage Wetness
564: Friendship-----	No major considerations or hazards
607: Pengilly-----	Flooding Wetness
615: Cowhorn-----	Wetness
617B: Goodland-----	Slope
618B: Itasca-----	Slope
621: Morph-----	Wetness
625: Sandwick-----	Wetness
627: Tawas-----	Susceptible to rutting and wheel slippage Wetness

## Forest Log Landing Considerations--Continued

Soil name and map symbol	Forest log landing considerations
628: Talmoon-----	Susceptible to rutting and wheel slippage Wetness
629B: Wawina-----	Slope
672: Willossippi-----	Susceptible to rutting and wheel slippage Wetness
685: Oesterle-----	Wetness
732B: Bushville-----	Slope Wetness
734: Cormant-----	Wetness
736: Ronneby-----	Wetness
Mora-----	Slope Wetness
738B: Milaca-----	Slope Wetness
Millward-----	Slope
738C: Milaca-----	Slope
Millward-----	Slope
759: Waukenabo-----	Susceptible to rutting and wheel slippage Wetness
795: Redby-----	Wetness
797: Mooselake-----	Susceptible to rutting and wheel slippage Wetness
Lupton-----	Susceptible to rutting and wheel slippage Wetness
798: Sago-----	Susceptible to rutting and wheel slippage Wetness
Roscommon-----	Wetness
869: Lobo-----	Susceptible to rutting and wheel slippage Wetness
Waskish-----	Susceptible to rutting and wheel slippage Wetness

## Forest Log Landing Considerations--Continued

Soil name and map symbol	Forest log landing considerations
870B, 870C, 870E:	
Itasca-----	Slope
Goodland-----	Slope
872:	
Pengilly-----	Flooding Wetness
Winterfield-----	Flooding Slope Wetness
928C, 928D, 928F:	
Cushing-----	Slope Susceptible to rutting and wheel slippage
Mahtomedi-----	Slope
980:	
Blackhoof-----	Susceptible to rutting and wheel slippage Wetness
Mahtowa-----	Susceptible to rutting and wheel slippage Wetness
990:	
Twig-----	Susceptible to rutting and wheel slippage Wetness
Giese-----	Susceptible to rutting and wheel slippage Wetness
1115:	
Newson-----	Wetness
1150:	
Jevne-----	Susceptible to rutting and wheel slippage Wetness
1154:	
Sax-----	Susceptible to rutting and wheel slippage Wetness
1353B:	
Cutaway-----	Slope Wetness
1354A:	
Aftad-----	Wetness
1372:	
Wealthwood-----	Wetness
1375B:	
Alban-----	Slope
1878:	
Hamre-----	Susceptible to rutting and wheel slippage Wetness

## Forest Log Landing Considerations--Continued

Soil name and map symbol	Forest log landing considerations
1982:	
Baudette-----	Susceptible to rutting and wheel slippage
Spooner-----	Susceptible to rutting and wheel slippage Wetness

## Forest Land Site Preparation and Planting Considerations

(Only the soils suitable for woodland are listed. See text for a description of the considerations listed in this table)

Soil name and map symbol	Site preparation and planting considerations
72: Shooker-----	Wetness
119C: Pomroy-----	Water erosion
124: Brickton-----	Wetness
133B: Dalbo-----	No major considerations or hazards
142: Nokay-----	Wetness
144B: Flak-----	Water erosion Wetness
144C: Flak-----	Water erosion
146B: Wabedo-----	Wetness
147: Spooner-----	Potential poor tilth and compaction Wetness
152B: Milaca-----	Water erosion Wetness
152C: Milaca-----	Water erosion
152E: Milaca-----	Slope Water erosion
164B: Mora-----	Wetness
166: Ronneby-----	Wetness
167B: Baudette-----	No major considerations or hazards
186: Nemadji-----	Wetness
188B: Omega-----	No major considerations or hazards
188C: Omega-----	Water erosion

## Forest Land Site Preparation and Planting Considerations--Continued

Soil name and map symbol	Site preparation and planting considerations
188E: Omega-----	Slope Water erosion
202: Meehan-----	Wetness
204B: Branstad-----	Wetness
204C: Cushing-----	Water erosion
204E: Cushing-----	Slope Water erosion
218: Watab-----	Wetness
240B: Warba-----	No major considerations or hazards
240C: Warba-----	Water erosion
243: Stuntz-----	Wetness
266: Freer-----	Potential poor tilth and compaction Wetness
268B: Cromwell-----	No major considerations or hazards
268C: Cromwell-----	Water erosion
268E, 268F: Cromwell-----	Slope Water erosion
292: Alstad-----	Wetness
302B: Rosholt-----	No major considerations or hazards
302C: Rosholt-----	Water erosion
346: Talmoon-----	Wetness
428: Hassman-----	Potential poor tilth and compaction Wetness
454B: Mahtomedi-----	No major considerations or hazards
454C: Mahtomedi-----	Water erosion

## Forest Land Site Preparation and Planting Considerations--Continued

Soil name and map symbol	Site preparation and planting considerations
454E, 454F: Mahtomedi-----	Slope Water erosion
458B: Menahga-----	No major considerations or hazards
458C: Menahga-----	Water erosion
458E: Menahga-----	Slope Water erosion
464B: Brennyville-----	Wetness
469B: Hillcity-----	No major considerations or hazards
502: Dusler-----	Wetness
504B: Duluth-----	No major considerations or hazards
504C: Duluth-----	Water erosion
504E: Duluth-----	Slope Water erosion
531: Beseman-----	Wetness
532: Sago-----	Wetness
533: Loxley-----	Wetness
540: Seelyeville-----	Wetness
541: Rifle-----	Wetness
543: Markey-----	Wetness
544: Cathro-----	Wetness
546: Lupton-----	Wetness
549: Greenwood-----	Wetness
564: Friendship-----	No major considerations or hazards

## Forest Land Site Preparation and Planting Considerations--Continued

Soil name and map symbol	Site preparation and planting considerations
607: Pengilly-----	Flooding Wetness
615: Cownhorn-----	Wetness
617B: Goodland-----	Water erosion
618B: Itasca-----	No major considerations or hazards
621: Morph-----	Wetness
625: Sandwick-----	Wetness
627: Tawas-----	Wetness
628: Talmoon-----	Wetness
629B: Wawina-----	Water erosion
672: Willossippi-----	Potential poor tilth and compaction Wetness
685: Oesterle-----	Wetness
732B: Bushville-----	Wetness
734: Cormant-----	Wetness
736: Ronneby-----	Wetness
Mora-----	Wetness
738B: Milaca-----	Water erosion Wetness
Millward-----	Water erosion
738C: Milaca-----	Water erosion
Millward-----	Water erosion
759: Waukenabo-----	Wetness
795: Redby-----	Wetness

## Forest Land Site Preparation and Planting Considerations--Continued

Soil name and map symbol	Site preparation and planting considerations
797:	
Mooselake-----	Wetness
Lupton-----	Wetness
798:	
Sago-----	Wetness
Roscommon-----	Wetness
869:	
Lobo-----	Wetness
Waskish-----	Wetness
870B:	
Itasca-----	No major considerations or hazards
Goodland-----	No major considerations or hazards
870C:	
Itasca-----	Water erosion
Goodland-----	Water erosion
870E:	
Itasca-----	Slope Water erosion
Goodland-----	Slope Water erosion
872:	
Pengilly-----	Flooding Wetness
Winterfield-----	Flooding Wetness
928C:	
Cushing-----	Water erosion
Mahtomedi-----	Water erosion
928D, 928F:	
Cushing-----	Slope Water erosion
Mahtomedi-----	Slope Water erosion
980:	
Blackhoof-----	Wetness
Mahtowa-----	Wetness
990:	
Twig-----	Wetness
Giese-----	Potential poor tilth and compaction Wetness

## Forest Land Site Preparation and Planting Considerations--Continued

Soil name and map symbol	Site preparation and planting considerations
1115: Newson-----	Wetness
1150: Jevne-----	Wetness
1154: Sax-----	Wetness
1353B: Cutaway-----	Wetness
1354A: Aftad-----	Wetness
1372: Wealthwood-----	Wetness
1375B: Alban-----	Water erosion
1878: Hamre-----	Wetness
1982: Baudette-----	No major considerations or hazards
Spooner-----	Potential poor tilth and compaction Wetness

# Recreation

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The soils of the survey area are rated in the table "Recreational Development" according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and frequency of flooding is essential in planning recreational facilities.

*Camp areas* are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The soils are rated on the basis of soil properties that influence the ease of developing camp areas and performance of the areas after development. Also considered are the soil properties that influence trafficability and promote the growth of vegetation after heavy use.

*Picnic areas* are natural or landscaped tracts of land that are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

*Playgrounds* are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and that can withstand heavy foot traffic and maintain an adequate cover of vegetation. The soils are rated on

the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

*Paths and trails* are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. The soils are rated on the basis of soil properties that influence trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

The interpretive ratings in this table help engineers, planners, and others to understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as slight, moderate, or severe.

*Slight* means that soil properties are favorable for the rated use. The limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

*Moderate* means that soil properties are moderately favorable for the rated use. The limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than that of soils rated *slight*.

*Severe* means that soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive

maintenance. Overcoming the limitations generally is difficult and costly.

The information in the table "Recreational Development" can be supplemented by other information in this survey, for example,

interpretations for dwellings without basements and for local roads and streets in the table "Building Site Development" and interpretations for septic tank absorption fields in the table "Sanitary Facilities."

## Recreational Development

(See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
72: Shooker-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
119C: Pomroy-----	Moderate: slope, percs slowly.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Severe: droughty.
124: Brickton-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
133B: Dalbo-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
142: Nokay-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
144B: Flak-----	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight-----	Moderate: droughty.
144C: Flak-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: droughty, slope.
146B: Wabedo-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
147: Spoonier-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
152B: Milaca-----	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight-----	Moderate: droughty.
152C: Milaca-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: droughty, slope.
152E: Milaca-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
164B: Mora-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Slight-----	Moderate: droughty.
166: Ronneby-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
167B: Baudette-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
186: Nemadji-----	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: too sandy, wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
188B: Omega-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
188C: Omega-----	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
188E: Omega-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
202: Meehan-----	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness, too sandy.	Severe: too acid.
204B: Branstad-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: large stones.
204C: Cushing-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: large stones, slope.
204E: Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
218: Watab-----	Severe: wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
240B: Warba-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
240C: Warba-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
243: Stuntz-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
266: Freer-----	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
268B: Cromwell-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
268C: Cromwell-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
268E: Cromwell-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
268F: Cromwell-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
292: Alstad-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness.
302B: Rosholt-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.
302C: Rosholt-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
346: Talmoon-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
428: Hassman-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
454B: Mahtomedi-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope.	Moderate: too sandy.	Moderate: droughty.
454C: Mahtomedi-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
454E: Mahtomedi-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy.	Severe: slope.
454F: Mahtomedi-----	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty, slope.
458B: Menahga-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
458C: Menahga-----	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
458E: Menahga-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
464B: Brennyville-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight-----	Slight.
469B: Hillcity-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
502: Dusler-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
504B: Duluth-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
504C: Duluth-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
504E: Duluth-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
531: Beseman-----	Severe: ponding, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
532: Sago-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
533: Loxley-----	Severe: ponding, excess humus, too acid.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, too acid.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
540: Seelyeville----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
541: Rifle-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
543: Markey-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
544: Cathro-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
546: Lupton-----	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
549: Greenwood-----	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
563: Northwood-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
564: Friendship-----	Severe: too acid.	Severe: too acid.	Severe: too acid.	Moderate: too sandy.	Severe: too acid.
607: Pengilly-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
615: Cowhorn-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
617B: Goodland-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.
618B: Itasca-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
621: Morph-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
625: Sandwick-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
627: Tawas-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
628: Talmoon-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
629B: Wawina-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
672: Willossippi-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
685: Oesterle-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: large stones, wetness, droughty.
732B: Bushville-----	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: slope, too sandy, wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
734: Cormant-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
736: Ronneby-----	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Mora-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Slight-----	Moderate: droughty.
738B: Milaca-----	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight-----	Moderate: droughty.
Millward-----	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: droughty.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
738C: Milaca-----	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight-----	Moderate: droughty, slope.
Millward-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: droughty, slope.
759: Waukenabo-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
795: Redby-----	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: too sandy, wetness.	Moderate: wetness, too sandy.	Moderate: wetness, droughty.
797: Mooselake-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Lupton-----	Severe: wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness.	Severe: wetness, excess humus.	Severe: wetness, excess humus.
798: Sago-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Roscommon-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
799: Seelyeville----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Bowstring-----	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
869: Lobo-----	Severe: wetness, excess humus, too acid.	Severe: wetness, excess humus, too acid.	Severe: excess humus, wetness, too acid.	Severe: wetness, excess humus.	Severe: too acid, wetness, excess humus.
Waskish-----	Severe: wetness, excess humus, too acid.	Severe: wetness, excess humus, too acid.	Severe: excess humus, wetness, too acid.	Severe: wetness, excess humus.	Severe: too acid, wetness, excess humus.
870B: Itasca-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.
Goodland-----	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.	Slight.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
870C:					
Itasca-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Goodland-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
870E:					
Itasca-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Goodland-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
872:					
Pengilly-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
Winterfield----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
928C:					
Cushing-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Moderate: large stones.
Mahtomedi-----	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty.
928D:					
Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Mahtomedi-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy.	Severe: slope.
928F:					
Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mahtomedi-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
980:					
Blackhoof-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Mahtowa-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
990:					
Twig-----	Severe: ponding, percs slowly, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, percs slowly.	Severe: ponding, excess humus.	Severe: too acid, ponding, excess humus.
Giese-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1002: Borosaprists----	Severe: flooding, wetness, excess humus.	Severe: wetness, excess humus.	Severe: excess humus, wetness, flooding.	Severe: wetness, excess humus.	Severe: wetness, flooding, excess humus.
Fluvaquents----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1030: Pits.					
Udipsammets----	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: slope.
1031: Histosols-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1072: Udorthents.					
1115: Newson-----	Severe: ponding.	Severe: ponding, too acid.	Severe: ponding.	Severe: ponding.	Severe: too acid, ponding.
1150: Jevne-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1154: Sax-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1353B: Cutaway-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones, too sandy.	Moderate: too sandy.	Moderate: droughty.
1354A: Aftad-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
1372: Wealthwood-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1375B: Alban-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
1878: Hamre-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

## Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1982: Baudette-----	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
Spooner-----	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1983: Cathro-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1984: Leafriver-----	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

# Wildlife Habitat

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Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing the existing plant cover, and fostering the natural establishment of desirable plants.

## Elements of Wildlife Habitat

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

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

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

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

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity, and flooding. The length of the growing season also is important.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, box elder, birch, maple, green ash, willow, and American elm. *Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Examples of fruit-producing shrubs that are suitable for planting on soils that have good potential for these plants are

hawthorn, honeysuckle, American plum, redosier dogwood, chokecherry, serviceberry, silver buffaloberry, and crabapple.

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

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of the root zone, the amount of water available to plants, and wetness.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweeds, wild millet, rushes, sedges, bulrushes, wild rice, arrowhead, waterplantain, cattail, prairie cordgrass, bluejoint grass, asters, and beggarticks.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

*Shallow water areas* have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability.

## Kinds of Wildlife Habitat

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include Hungarian partridge, ring-necked pheasant, sharp-tailed grouse, meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

*Habitat for woodland wildlife* consists of areas of hardwoods or conifers or a mixture of these and

associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include wild turkey, ruffed grouse, thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, white-tailed deer, black bear, and moose.

*Habitat for wetland wildlife* consists of open,

marshy or swampy shallow water areas, bogs, or flood plains that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, bitterns, rails, kingfishers, muskrat, otter, mink, and beaver.

## Wildlife Habitat

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
72: Shooker-----	Poor	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good.
119C: Pomroy-----	Fair	Fair	Good	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.
124: Brickton-----	Poor	Fair	Fair	Good	Poor	---	Good	Good	Fair	Fair	Good.
133B: Dalbo-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
142: Nokay-----	Fair	Good	Good	Good	Good	---	Fair	Poor	Good	Good	Fair.
144B, 144C: Flak-----	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
146B: Wabedo-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
147: Spoonier-----	Poor	Fair	Good	Fair	Fair	---	Good	Good	Fair	Fair	Good.
152B, 152C: Milaca-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
152E: Milaca-----	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
164B: Mora-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
166: Ronneby-----	Fair	Fair	Good	Good	Good	---	Good	Good	Good	Good	Good.
167B: Baudette-----	Good	Good	Good	Good	Fair	---	Very poor.	Very poor.	Good	Good	Very poor.
186: Nemadji-----	Poor	Fair	Good	Fair	Good	---	Good	Good	Fair	Good	Good.
188B, 188C: Omega-----	Poor	Fair	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.
188E: Omega-----	Very poor.	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Very poor.	Poor	Very poor.

## Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements									Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
202: Meehan-----	Poor	Fair	Good	Fair	Fair	---	Fair	Fair	Fair	Fair	Fair.
204B: Branstad-----	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
204C: Cushing-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
204E: Cushing-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.
218: Watab-----	Fair	Fair	Good	Good	Fair	---	Good	Good	Fair	Good	Good.
240B: Warba-----	Good	Good	Good	Good	Poor	---	Very poor.	Very poor.	Good	Good	Very poor.
240C: Warba-----	Fair	Good	Good	Good	Poor	---	Very poor.	Very poor.	Good	Good	Very poor.
243: Stuntz-----	Fair	Good	Good	Good	Fair	Good	Fair	Fair	Fair	Good	Fair.
266: Freer-----	Good	Good	Good	Good	Good	Good	Fair	Poor	Good	Good	Fair.
268B, 268C: Cromwell-----	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.
268E, 268F: Cromwell-----	Poor	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.
292: Alstad-----	Good	Good	Good	Good	Good	---	Fair	Fair	Good	Good	Fair.
302B: Rosholt-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
302C: Rosholt-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
346: Talmoon-----	Good	Good	Good	Good	Good	---	Good	Good	Good	Good	Good.
428: Hassman-----	Very poor.	Fair	Fair	Good	Poor	---	Good	Good	Very poor.	Fair	Good.
454B, 454C: Mahtomedi-----	Poor	Fair	Fair	Poor	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.

## Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
454E, 454F: Mahtomedi-----	Very poor.	Poor	Fair	Poor	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.
458B, 458C: Menahga-----	Poor	Poor	Fair	Poor	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.
458E: Menahga-----	Very poor.	Poor	Fair	Poor	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.
464B: Brennyville-----	Good	Good	Good	Good	Good	---	Fair	Very poor.	Good	Good	Fair.
469B: Hillcity-----	Good	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
502: Dusler-----	Good	Good	Good	Fair	Good	---	Good	Good	Good	Good	Good.
504B: Duluth-----	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor.
504C: Duluth-----	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Poor	Good	Very poor.
504E: Duluth-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Poor	Good	Very poor.
531: Beseman-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Very poor.	Very poor.	Good.
532: Sago-----	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
533: Loxley-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
540: Seelyeville-----	Very poor.	Poor	Good	Poor	Poor	---	Good	Good	Fair	Poor	Good.
541: Rifle-----	Fair	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
543: Markey-----	Very poor.	Very poor.	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
544: Cathro-----	Poor	Fair	Fair	Fair	Fair	---	Good	Good	Poor	Fair	Good.
546: Lupton-----	Fair	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.

## Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
549: Greenwood-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
563: Northwood-----	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
564: Friendship-----	Poor	Fair	Good	Fair	Good	---	Poor	Very poor.	Fair	Good	Very poor.
607: Pengilly-----	Poor	Poor	Fair	Fair	Fair	---	Fair	Good	Poor	Poor	Good.
615: Cownhorn-----	Fair	Good	Good	Good	Good	---	Fair	Fair	Fair	Good	Fair.
617B: Goodland-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
618B: Itasca-----	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
621: Morph-----	Fair	Fair	Good	Fair	Fair	---	Good	Fair	Fair	Fair	Fair.
625: Sandwick-----	Poor	Fair	Good	Good	Good	---	Poor	Fair	Fair	Good	Poor.
627: Tawas-----	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
628: Talmoon-----	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
629B: Wawina-----	Fair	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.
672: Willossippi-----	Fair	Good	Good	Good	Good	---	Good	Good	Fair	Good	Good.
685: Oesterle-----	Fair	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor.
732B: Bushville-----	Fair	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Poor.
734: Cormant-----	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
736: Ronneby-----	Fair	Fair	Good	Good	Good	---	Good	Good	Good	Good	Good.
Mora-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

## Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
738B:											
Milaca-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Millward-----	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
738C:											
Milaca-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Millward-----	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
759:											
Waukenabo-----	Fair	Good	Good	Good	Good	---	Fair	Fair	Fair	Good	Fair.
795:											
Redby-----	Poor	Fair	Good	Fair	Good	---	Fair	Fair	Fair	Good	Fair.
797:											
Mooselake-----	Very poor.	Poor	Poor	Poor	Fair	---	Good	Good	Poor	Poor	Good.
Lupton-----	Fair	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
798:											
Sago-----	Very poor.	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Roscommon-----	Poor	Poor	Poor	Fair	Fair	---	Good	Good	Poor	Fair	Good.
799:											
Seelyville-----	Very poor.	Poor	Good	Poor	Poor	---	Good	Good	Good	Fair	Good.
Bowstring-----	Very poor.	Poor	Good	Poor	Poor	Fair	Good	Good	Poor	Poor	Good.
869:											
Lobo-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Fair.
Waskish-----	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
870B:											
Itasca-----	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Goodland-----	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
870C:											
Itasca-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Goodland-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

## Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
870E:											
Itasca-----	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Goodland-----	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
872:											
Pengilly-----	Poor	Poor	Fair	Fair	Fair	---	Fair	Good	Poor	Poor	Good.
Winterfield-----	Poor	Fair	Fair	Fair	Fair	---	Fair	Fair	Fair	Fair	Fair.
928C:											
Cushing-----	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
Mahtomedi-----	Poor	Fair	Fair	Poor	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.
928D, 928F:											
Cushing-----	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.
Mahtomedi-----	Very poor.	Poor	Fair	Poor	Fair	---	Very poor.	Very poor.	Poor	Fair	Very poor.
980:											
Blackhoof-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
Mahtowa-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
990:											
Twig-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
Giese-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
1002:											
Borosaprists-----	Poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Fluvaquents-----	Poor	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
1030: Pits.  Udipsammments.											
1031:											
Histosols-----	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Good	Poor	Good.
1072: Udorthents.											
1115:											
Newson-----	Fair	Fair	Fair	Poor	Poor	---	Good	Good	Fair	Poor	Good.

Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life
1150: Jevne-----	Fair	Good	Good	Good	Good	---	Good	Good	Fair	Good	Good.
1154: Sax-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
1353B: Cutaway-----	Fair	Fair	Good	Good	Good	---	Poor	Very poor.	Fair	Good	Very poor.
1354A: Aftad-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
1372: Wealthwood-----	Poor	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Fair.
1375B: Alban-----	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
1878: Hamre-----	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
1982: Baudette-----	Good	Good	Good	Good	Fair	---	Poor	Poor	Good	Good	Poor.
Spoooner-----	Poor	Fair	Good	Fair	Fair	---	Good	Good	Fair	Fair	Good.
1983: Cathro-----	Poor	Fair	Fair	Poor	Poor	---	Good	Good	Poor	Poor	Good.
1984: Leafriver-----	Very poor.	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.

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# Engineering

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This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial,

industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

## Building Site Development

The table "Building Site Development" shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties,

site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

## Sanitary Facilities

The table "Sanitary Facilities" shows the degree and the kind of soil limitations that affect septic tank

absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of *slight*, *moderate*, or *severe* are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of *good*, *fair*, and *poor* are given for daily cover for landfill.

A rating of *slight* or *good* indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of *moderate* or *fair* indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of *severe* or *poor* indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

*Septic tank absorption fields* are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a

nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively impervious soil material for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

The table "Sanitary Facilities" gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Trench sanitary landfill* is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

*Area sanitary landfill* is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in the table "Sanitary Facilities" are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones

and boulders, highly organic layers, soil reaction, and content of salts affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

## Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

## Construction Materials

The table "Construction Materials" gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In the table "Construction Materials," the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of

suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In the table "Construction Materials," only the probability of finding material in suitable quantity in or below the soil is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

## Water Management

The table “Water Management” gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In the table “Water Management,” the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the

embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

*Aquifer-fed excavated ponds* are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts. Availability of drainage outlets is not considered in the ratings.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff.

Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an

excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock

affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts, and restricted permeability adversely affect the growth and maintenance of the grass after construction.



## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
164B: Mora-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: droughty.
166: Ronneby-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
167B: Baudette-----	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
186: Nemadji-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
188B: Omega-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
188C: Omega-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
188E: Omega-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
202: Meehan-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Severe: too acid.
204B: Branstad-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Moderate: large stones.
204C: Cushing-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: large stones, slope.
204E: Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
218: Watab-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
240B: Warba-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
240C: Warba-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
243: Stuntz-----	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
266: Freer-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
268B: Cromwell-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
268C: Cromwell-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
268E: Cromwell-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
268F: Cromwell-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
292: Alstad-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness.
302B: Rosholt-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
302C: Rosholt-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
346: Talmoon-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
428: Hassman-----	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, excess humus.
454B: Mahtomed1-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
454C: Mahtomedi-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
454E: Mahtomedi-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
454F: Mahtomedi-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
458B: Menahga-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: droughty.
458C: Menahga-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
458E: Menahga-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
464B: Brennyville----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
469B: Hillcity-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
502: Dusler-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Moderate: wetness.
504B: Duluth-----	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
504C: Duluth-----	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
504E: Duluth-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
531: Beseman-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: too acid, ponding, excess humus.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
532: Sago-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
533: Loxley-----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: too acid, ponding, excess humus.
540: Seelyeville----	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
541: Rifle-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, excess humus.
543: Markey-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
544: Cathro-----	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
546: Lupton-----	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
549: Greenwood-----	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
563: Northwood-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
564: Friendship-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Slight-----	Severe: too acid.
607: Pengilly-----	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
615: Cowhorn-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
617B: Goodland-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
618B: Itasca-----	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: frost action.	Slight.
621: Morph-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
625: Sandwick-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness.
627: Tawas-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
628: Talmoon-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding, excess humus.
629B: Wawina-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
672: Willossippi-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
685: Oesterle-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: large stones, wetness, droughty.
732B: Bushville-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
734: Cormant-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
736: Ronneby-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
Mora-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: droughty.
738B: Milaca-----	Moderate: dense layer, wetness.	Slight-----	Moderate: wetness.	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
Millward-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
738C: Milaca-----	Moderate: dense layer, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
Millward-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
759: Waukenabo-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
795: Redby-----	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
797: Mooselake-----	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Lupton-----	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: wetness, excess humus.
798: Sago-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
Roscommon-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
799: Seelyeville-----	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Bowstring-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
869: Lobo-----	Severe: excess humus, wetness.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, low strength.	Severe: subsides, wetness, frost action.	Severe: too acid, wetness, excess humus.
Waskish-----	Severe: excess humus, wetness.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, low strength.	Severe: wetness, frost action.	Severe: too acid, wetness, excess humus.
870B: Itasca-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
Goodland-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
870C: Itasca-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Goodland-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
870E: Itasca-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Goodland-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
872: Pengilly-----	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
Winterfield-----	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
928C: Cushing-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Moderate: large stones.
Mahtomedi-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight-----	Moderate: droughty.
928D: Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mahtomedi-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
928F: Cushing-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Mahtomedi-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
980: Blackhoof-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding, excess humus.
Mahtowa-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
990: Twig-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: too acid, ponding, excess humus.
Giese-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1002: Borosaprist-----	Severe: cutbanks cave, excess humus, wetness.	Severe: flooding, wetness, low strength.	Severe: flooding, wetness.	Severe: flooding, wetness, low strength.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding, excess humus.
Fluvaquents-----	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
1030: Pits.						
Udipsammets-----	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1031: Histosols-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: ponding, excess humus.
1072: Udorthents.						
1115: Newson-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: too acid, ponding.

## Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1150: Jevne-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1154: Sax-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1353B: Cutaway-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness, shrink-swell.	Slight-----	Slight-----	Moderate: droughty.
1354A: Aftad-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.	Slight.
1372: Wealthwood-----	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1375B: Alban-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.	Slight.
1878: Hamre-----	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.
1982: Baudette-----	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Spooner-----	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, frost action.	Severe: wetness.
1983: Cathro-----	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
1984: Leafriver-----	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding, excess humus.

## Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
72: Shooker-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
119C: Pomroy-----	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
124: Brickton-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
133B: Dalbo-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
142: Nokay-----	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
144B: Flak-----	Severe: wetness, percs slowly.	Severe: seepage.	Moderate: wetness.	Slight-----	Fair: small stones.
144C: Flak-----	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
146B: Wabedo-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness, too sandy.	Moderate: wetness.	Fair: too sandy, small stones, wetness.
147: Spooner-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
152B: Milaca-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness.	Slight-----	Fair: small stones, wetness.
152C: Milaca-----	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
152E: Milaca-----	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
164B: Mora-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness.	Moderate: wetness.	Fair: small stones, wetness.
166: Ronneby-----	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
167B: Baudette-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
186: Nemadji-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
188B: Omega-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
188C: Omega-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
188E: Omega-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
202: Meehan-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
204B: Branstad-----	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: small stones, wetness.
204C: Cushing-----	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
204E: Cushing-----	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
218: Watab-----	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
240B: Warba-----	Severe: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
240C: Warba-----	Severe: percs slowly.	Severe: seepage, slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
243: Stuntz-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
266: Freer-----	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
268B: Cromwell-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
268C: Cromwell-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
268E, 268F: Cromwell-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
292: Alstad-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
302B: Rosholt-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
302C: Rosholt-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
346: Talmoon-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
428: Hassman-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
454B: Mahtomedi-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
454C: Mahtomedi-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
454E, 454F: Mahtomedi-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
458B: Menahga-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458C: Menahga-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
458E: Menahga-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
464B: Brennyville-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.
469B: Hillcity-----	Severe: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Good.
502: Dusler-----	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
504B: Duluth-----	Severe: wetness, percs slowly.	Moderate: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
504C: Duluth-----	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
504E: Duluth-----	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
531: Beseman-----	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus, too acid.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
532: Sago-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
533: Loxley-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus, too acid.
540: Seelyeville----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
541: Rifle-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
543: Markey-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
544: Cathro-----	Severe: ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
546: Lupton-----	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
549: Greenwood-----	Severe: subsides, wetness.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
563: Northwood-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
564: Friendship-----	Severe: wetness, poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
607: Pengilly-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
615: Cownhorn-----	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
617B: Goodland-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
618B: Itasca-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
621: Morph-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
625: Sandwick-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: wetness.
627: Tawas-----	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
628: Talmoon-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
629B: Wawina-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy.
672: Willossippi-----	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
685: Oesterle-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
732B: Bushville-----	Severe: wetness, percs slowly.	Severe: seepage.	Severe: wetness.	Severe: seepage.	Fair: wetness.
734: Cormant-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
736: Ronneby-----	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Mora-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness.	Moderate: wetness.	Fair: small stones, wetness.
738B: Milaca-----	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Moderate: wetness.	Slight-----	Fair: small stones, wetness.
Millward-----	Severe: poor filter.	Severe: seepage.	Slight-----	Severe: seepage.	Fair: small stones.
738C: Milaca-----	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
Millward-----	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope.	Severe: seepage.	Fair: small stones, slope.
759: Waukenabo-----	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
795: Redby-----	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
797: Mooselake-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
Lupton-----	Severe: subsides, wetness, percs slowly.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus.
798: Sago-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, too sandy.	Severe: ponding.	Poor: too sandy, ponding.
Roscommon-----	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
799: Seelyeville-----	Severe: subsides, flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
Bowstring-----	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
869: Lobo-----	Severe: subsides, wetness, poor filter.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus, too acid.
Waskish-----	Severe: wetness, poor filter.	Severe: seepage, excess humus, wetness.	Severe: seepage, wetness, excess humus.	Severe: seepage, wetness.	Poor: wetness, excess humus, too acid.
870B: Itasca-----	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
Goodland-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
870C: Itasca-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Goodland-----	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
870E: Itasca-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Goodland-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
872: Pengilly-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Winterfield----	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
928C: Cushing-----	Severe: percs slowly.	Moderate: seepage, slope.	Slight-----	Slight-----	Fair: small stones.
Mahtomedi-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
928D, 928F: Cushing-----	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Mahtomedi-----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
980: Blackhoof-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Mahtowa-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
990: Twig-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, too acid.	Severe: ponding.	Poor: ponding, too acid.
Giese-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1002: Borosaprists----	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, excess humus.
Fluvaquents-----	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
1030: Pits.					
Udipsamments----	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
1031: Histosols-----	Severe: ponding.	Severe: seepage, excess humus.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding, excess humus.
1072: Udorthents.					
1115: Newson-----	Severe: ponding, poor filter.	Severe: seepage.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
1150: Jevne-----	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
1154: Sax-----	Severe: ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1353B: Cutaway-----	Severe: wetness, percs slowly, poor filter.	Severe: seepage.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey.
1354A: Aftad-----	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Fair: wetness.

## Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1372: Wealthwood-----	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
1375B: Alban-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too sandy.	Slight-----	Fair: too sandy, thin layer.
1878: Hamre-----	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1982: Baudette-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
Spooner-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1983: Cathro-----	Severe: ponding, percs slowly, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: too sandy, ponding.
1984: Leafriver-----	Severe: ponding, poor filter.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

## Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
72: Shooker-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
119C: Pomroy-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
124: Brickton-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
133B: Dalbo-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
142: Nokay-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
144B, 144C: Flak-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
146B: Wabedo-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
147: Spooner-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
152B, 152C: Milaca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
152E: Milaca-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
164B: Mora-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
166: Ronneby-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
167B: Baudette-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
186: Nemadji-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
188B, 188C: Omega-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
188E: Omega-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
202: Meehan-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, too acid.
204B: Branstad-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
204C: Cushing-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
204E: Cushing-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
218: Watab-----	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, wetness.
240B: Warba-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
240C: Warba-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
243: Stuntz-----	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
266: Freer-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
268B, 268C: Cromwell-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
268E: Cromwell-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
268F: Cromwell-----	Poor: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, small stones, slope.
292: Alstad-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
302B, 302C: Rosholt-----	Good-----	Probable-----	Probable-----	Poor: small stones, area reclaim.
346: Talmoon-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
428: Hassman-----	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
454B, 454C: Mahtomedi-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
454E: Mahtomedi-----	Fair: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
454F: Mahtomedi-----	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
458B, 458C: Menahga-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
458E: Menahga-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: too sandy, slope.
464B: Brennyville-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
469B: Hillcity-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
502: Dusler-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
504B: Duluth-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
504C: Duluth-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
504E: Duluth-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
531: Beseman-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
532: Sago-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
533: Loxley-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
540: Seelyeville----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
541: Rifle-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
543: Markey-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
544: Cathro-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
546: Lupton-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
549: Greenwood-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
563: Northwood-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
564: Friendship-----	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
607: Pengilly-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
615: Cownhorn-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
617B: Goodland-----	Good-----	Probable-----	Improbable: too sandy.	Fair: area reclaim, small stones.
618B: Itasca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
621: Morph-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
625: Sandwick-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
627: Tawas-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
628: Talmoon-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
629B: Wawina-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
672: Willosippi-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
685: Oesterle-----	Fair: wetness.	Probable-----	Probable-----	Poor: small stones, area reclaim.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
732B: Bushville-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
734: Cormant-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
736: Ronneby-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Mora-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
738B, 738C: Milaca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Millward-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
759: Waukenabo-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
795: Redby-----	Fair: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy.
797: Mooselake-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Lupton-----	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
798: Sago-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, wetness.
Roscommon-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
799: Seelyville-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Bowstring-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
869: Lobo-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
869: Waskish-----	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
870B: Itasca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Goodland-----	Good-----	Probable-----	Improbable: too sandy.	Fair: area reclaim, small stones.
870C: Itasca-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Goodland-----	Good-----	Probable-----	Improbable: too sandy.	Fair: area reclaim, small stones, slope.
870E: Itasca-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Goodland-----	Fair: slope.	Probable-----	Improbable: too sandy.	Poor: slope.
872: Pengilly-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Winterfield-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
928C: Cushing-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Mahtomedi-----	Good-----	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
928D: Cushing-----	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Mahtomedi-----	Fair: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
928F: Cushing-----	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
928F: Mahtomedi-----	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, small stones, area reclaim.
980: Blackhoof-----	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Mahtowa-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
990: Twig-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, wetness, too acid.
Giese-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, wetness.
1002: Borosaprists---	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Fluvaquents----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1030: Pits.				
Udipsamments---	Poor: slope.	Probable-----	Probable-----	Poor: too sandy, slope.
1031: Histosols-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: excess humus, wetness.
1072: Udorthents.				
1115: Newson-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.
1150: Jevne-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1154: Sax-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1353B: Cutaway-----	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

## Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1354A: Aftad-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1372: Wealthwood-----	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, wetness.
1375B: Alban-----	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy, small stones.
1878: Hamre-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1982: Baudette-----	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Spooner-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1983: Cathro-----	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
1984: Leafriver-----	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: too sandy, wetness.

Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
72: Shooker-----	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action----	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
119C: Pomroy-----	Severe: seepage, slope.	Moderate: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
124: Brickton-----	Slight-----	Severe: thin layer, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Prodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
133B: Dalbo-----	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Slope, wetness.	Wetness-----	Percs slowly.
142: Nokay-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, droughty, soil blowing.	Wetness, soil blowing, percs slowly.	Wetness, droughty, rooting depth.
144B: Flak-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
144C: Flak-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, soil blowing, percs slowly.	Slope, droughty, rooting depth.
146B: Wabedo-----	Moderate: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Percs slowly, slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth, percs slowly.

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
147: Spooner-----	Moderate: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
152B: Milaca-----	Moderate: slope.	Moderate: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Percs slowly---	Droughty, rooting depth.
152C, 152E: Milaca-----	Severe: slope.	Moderate: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, percs slowly.	Slope, droughty.
164B: Mora-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, droughty.	Wetness, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
166: Ronneby-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness-----	Wetness, rooting depth, percs slowly.
167B: Baudette-----	Moderate: seepage, slope.	Severe: piping.	Severe: cutbanks cave.	Frost action, slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
186: Nemadji-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
188B: Omega-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
188C, 188E: Omega-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
202: Meehan-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave, too acid.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
204B: Branstad-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Slope-----	Slope, wetness.	Wetness-----	Favorable.
204C, 204E: Cushing-----	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope-----	Slope-----	Slope.
218: Watab-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: no water.	Percs slowly, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting de
240B: Warba-----	Moderate: seepage, slope.	Moderate: wetness.	Severe: slow refill.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
240C: Warba-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
243: Stuntz-----	Slight-----	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness, soil blowing.	Wetness, soil blowing.	Favorable.
266: Freer-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
268B: Cromwell-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.

## Water Management--Continued

Soil name and map symbol	Limitations for--			Drainage	Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds		Irrigation	Terraces and diversions	Grassed waterways
268C, 268E, 268F: Cromwell-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
292: Aistad-----	Moderate: seepage.	Severe: thin layer.	Severe: no water.	Frost action---	Wetness-----	Wetness-----	Wetness.
302B: Rosholt-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
302C: Rosholt-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
346: Talmoon-----	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Frost action---	Wetness, soil blowing.	Erodes easily, wetness, soil blowing.	Wetness, erodes easily.
428: Hassman-----	Slight-----	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
454B: Mahtomedi-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
454C, 454E, 454F: Mahtomedi-----	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.
458B: Menahga-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
458C, 458E: Menahga-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
464B: Brennyville-----	Moderate: seepage, slope.	Moderate: seepage, piping, wetness.	Severe: no water.	percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
469B: Hillcity-----	Moderate: seepage, slope.	Severe: piping.	Severe: slow refill.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
502: Dusler-----	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily.
504B: Duluth-----	Moderate: slope.	Moderate: piping, wetness.	Severe: slow refill.	Deep to water	Slope, soil blowing, percs slowly.	Erodes easily, soil blowing, percs slowly.	Erodes easily, rooting depth, percs slowly.
504C, 504E: Duluth-----	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Slope, erodes easily, soil blowing.	Slope, erodes easily, rooting depth.
531: Beseman-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing, rooting depth.	Ponding, soil blowing.	Wetness, rooting depth.
532: Sago-----	Moderate: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
533: Loxley-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, too acid.	Ponding-----	Wetness.

Water Management --Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
540: Seelyeville-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
541: Rifle-----	Severe: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, frost action.	Ponding-----	Ponding-----	Wetness.
543: Markey-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
544: Cathro-----	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
546: Lupton-----	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill.	Subsides, frost action.	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
549: Greenwood-----	Severe: seepage.	Severe: excess humus, wetness.	Moderate: slow refill.	Subsides, frost action.	Wetness-----	Wetness-----	Wetness.
563: Northwood-----	Severe: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing, rooting depth.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.
564: Friendship-----	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
607: Pengilly-----	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness-----	Wetness.

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
615: Cowhorn-----	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, fast intake, soil blowing.	Erodes easily, wetness, soil blowing.	Erodes easily.
617B: Goodland-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Erodes easily, too sandy.	Erodes easily, rooting depth.
618B: Itasca-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
621: Morph-----	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, soil blowing.	Wetness, too sandy, soil blowing.	Wetness.
625: Sandwick-----	Severe: seepage.	Severe: wetness.	Severe: slow refill, cutbanks cave.	Favorable-----	Wetness, droughty, fast intake.	Wetness, soil blowing.	Wetness, droughty, rooting depth.
627: Tawas-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
628: Talmoon-----	Slight-----	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
629B: Hawina-----	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Soil blowing----	Favorable.
672: Willosippi-----	Moderate: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Wetness, too sandy.	Wetness.

## Water Management---Continued

Soil name and map symbol	Limitations for---			Features affecting---			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Crossed waterways
685: Oosterle-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness, droughty, soil blowing.	Wetness, too sandy.	Wetness, droughty.
732B: Bushville-----	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, slope.	Slope, wetness, droughty.	Wetness, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
734: Cormant-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
736: Ronney-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, soil blowing, percs slowly.	Wetness, soil blowing.	Wetness, rooting depth, percs slowly.
Mora-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, droughty.	Wetness, soil blowing, percs slowly.	Droughty, rooting depth, percs slowly.
738B: Milaca-----	Moderate: slope.	Moderate: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Percs slowly---	Droughty, rooting depth.
Millward-----	Severe: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Slope, droughty, rooting depth.	Soil blowing---	Droughty, rooting depth.
738C: Milaca-----	Severe: slope.	Moderate: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, percs slowly.	Slope, droughty.
Millward-----	Severe: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope, droughty, rooting depth.	Slope, soil blowing.	Slope, droughty, rooting depth.



## Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
869: Maskish-----	Severe: seepage.	Severe: excess humus, wetness.	Slight-----	Frost action, too acid.	Wetness, too acid.	Wetness-----	Wetness.
870B: Itasca-----	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Erodes easily	Erodes easily, rooting depth.
Goodland-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Erodes easily, too sandy.	Erodes easily, rooting depth.
870C, 870E: Itasca-----	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Goodland-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, erodes easily, too sandy.	Slope, erodes easily, rooting depth.
872: Pengilly-----	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness-----	Wetness.
Winterfield-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
928C: Cushing-----	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
Mahtomedi-----	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
928D: Cushing-----	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope-----	Slope-----	Slope.

Water Management--Continued

Soil name and map symbol	Limitations for--				Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways	
928D: Mahtomedi-----	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.	
928F: Cushing-----	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.	
Mahtomedi-----	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy.	Slope, droughty, rooting depth.	
980: Blackhoof-----	Slight-----	Severe: piping, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, rooting depth, percs slowly.	
Mahtowa-----	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing, rooting depth.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.	
990: Twig-----	Slight-----	Severe: piping, ponding.	Severe: no water.	Ponding, percs slowly, subsides.	Ponding, soil blowing, percs slowly.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily, rooting depth.	
Giese-----	Moderate: seepage.	Severe: piping, ponding.	Severe: no water.	Ponding, percs slowly, frost action.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, rooting depth, percs slowly.	
1002: Borosaprist-----	Severe: seepage.	Severe: excess humus, wetness.	Severe: slow refill, cutbanks cave.	Flooding, frost action.	Wetness, soil blowing, flooding.	Wetness, soil blowing.	Wetness.	
Fluvaquents-----	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Wetness.	
1030: Pits.								
Udipsammits-----	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.	

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1031: Histosols-----	Severe: seepage.	Severe: excess humus, ponding.	Severe: cutbanks cave.	Ponding, subsides.	Ponding-----	Ponding-----	Wetness.
1072: Udorthents.							
1115: Newson-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty, rooting depth.
1150: Jevne-----	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Frost action---	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
1154: Sax-----	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
1353B: Cutaway-----	Severe: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Erodes easily, soil blowing.	Erodes easily, droughty, rooting depth.
1354A: Aftad-----	Moderate: seepage.	Severe: piping.	Severe: no water.	Favorable-----	Wetness, soil blowing.	Erodes easily, wetness, soil blowing.	Erodes easily, rooting depth.
1372: Wealthwood-----	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
1375B: Alban-----	Moderate: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Too sandy-----	Favorable.

Water Management--Continued

Soil name and map symbol	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1878: Hamre-----	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
1982: Baudette-----	Moderate: seepage.	Severe: piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness-----	Erodes easily, wetness.	Erodes easily.
Spooner-----	Moderate: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Frost action---	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
1983: Cathro-----	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
1984: Leafriver-----	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.

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# Soil Properties

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

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

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

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

## Engineering Index Properties

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

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

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and

less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

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

In the table "Physical Properties of the Soils," *depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

*Clay* as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at  $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In

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

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

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. It is not an estimate of the quantity of water actually available to plants at any given time.

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity.

The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In the table "Physical Properties of the Soils," the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

*Erosion factor Kf* indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

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

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

1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
- 4L. Calcareous loams, silt loams, clay loams,

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

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

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

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils have less than 5 percent finely divided calcium carbonate. They are moderately erodible. Crops can be grown if ordinary measures to control wind erosion are used.

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

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

The *wind erodibility index* is determined based on the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. It is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles.

In the table "Chemical Properties of the Soils," *cation-exchange capacity* is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. It is a measurement of the nutrient-holding capacity of the soil.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

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

## Water Features

The table "Water Features" gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

*Hydrologic soil groups* are groups of soils that, when saturated, have the same runoff potential under similar storm and ground cover conditions. The soil properties that affect the runoff potential are those that influence the minimum rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well or well drained soils that have a moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils that have a moderately fine or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clayey soils that have a high

shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

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

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

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is a zone of saturation at the highest average depth during the wettest season. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Indicated in the table are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An *apparent* water table is indicated by the level at

which water stands in a freshly dug, unlined borehole after adequate time for adjustments in the surrounding soil.

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

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

## Soil Features

The table "Soil Features" gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

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

*Subsidence* is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength

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

A *low* potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a *moderate* potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a *high* potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate content, texture, moisture content, and acidity of the soil.

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

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

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

## Engineering Index Properties

(Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
72: Shooker-----	0-9	Very fine sandy loam.	SM, ML, SC-SM, CL-ML	A-4	0	0-3	95-100	90-98	80-95	35-60	15-28	1-7
	9-27	Loam, clay loam, sandy clay loam.	ML, CL, CL-ML	A-6, A-4	0	0-3	95-100	90-98	70-95	50-70	20-40	3-20
	27-60	Loam, fine sandy loam, sandy loam.	ML, CL, SC, SM	A-4, A-6	0	0-3	95-100	90-98	70-95	40-65	20-40	2-20
119C: Pomroy-----	0-4	Loamy fine sand	SM	A-2, A-1-b	0	0	100	95-100	45-80	15-35	---	NP
	4-15	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-2, A-1-b	0	0	100	95-100	45-80	10-35	---	NP
	15-22	Fine sandy loam, sandy loam.	SM	A-4, A-2	0-1	0-10	85-95	75-85	50-70	25-45	15-22	NP-4
	22-44	Sandy loam, fine sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	75-85	50-70	25-40	15-22	NP-4
	44-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	70-90	50-70	25-40	15-22	NP-4
124: Brickton-----	0-11	Silt loam-----	CL-ML, ML	A-4	0	0	100	100	90-100	60-100	25-35	4-10
	11-32	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	0	100	95-100	90-100	85-100	40-65	20-40
	32-60	Silty clay, clay, silty clay loam.	CH, CL, ML, MH	A-6, A-7	0	0	100	95-100	90-100	85-100	35-60	10-35
133B: Dalbo-----	0-13	Very fine sandy loam.	SM, ML	A-4	0	0	100	100	75-90	35-60	15-25	NP-4
	13-35	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	0	100	100	85-100	75-95	40-65	20-40
	35-60	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	0	100	95-100	85-100	65-95	30-60	10-35

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
142: Nokay-----	0-6	Fine sandy loam	SM	A-2, A-4	0	0-2	90-100	80-98	55-85	25-50	15-25	NP-4
	6-12	Sandy loam, loam, gravelly sandy loam.	SM, ML	A-2, A-4	0	0-5	85-95	70-95	60-80	25-55	15-25	NP-4
	12-19	Sandy loam, loam, gravelly sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4	0	0-5	85-95	70-90	60-80	25-55	20-30	2-7
	19-44	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	85-95	70-90	60-75	25-40	15-25	NP-4
	44-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	85-95	70-90	60-75	25-40	15-25	NP-4
144B: Flak-----	0-3	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
	3-13	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	13-22	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	22-45	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
	45-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
144C: Flak-----	0-2	Sandy loam-----	SM	A-2, A-4	0-1	0-2	90-100	80-100	60-80	25-45	15-22	NP-4
	2-5	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-75	25-40	15-22	NP-4
	5-16	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	75-95	50-70	25-40	15-22	NP-4
	16-34	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4
	34-60	Sandy loam, gravelly sandy loam, loamy sand.	SM	A-2, A-4	0-2	0-5	85-95	65-95	50-70	25-40	15-22	NP-4

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
146B: Wabedo-----	0-5	Sandy loam-----	SM, SC-SM	A-2-4, A-4	0	0-2	90-100	80-98	60-85	25-45	15-25	2-7
	5-27	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4, A-1-b	0	0-4	70-100	60-95	35-75	20-50	0-25	NP-7
	27-47	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
	47-60	Sandy loam, loamy sand, gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-b	0	0-2	70-100	60-95	35-65	15-35	0-25	NP-7
147: Spooner-----	0-4	Silt loam-----	ML	A-4, A-6	0	0	100	100	90-100	50-80	25-40	1-14
	4-10	Loamy very fine sand, very fine sandy loam, loam.	SM, ML, SC, CL	A-4, A-6	0	0	100	100	90-100	35-60	10-40	1-15
	10-29	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-85	20-40	5-15
	29-60	Very fine sandy loam, silt loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	0	100	100	90-100	35-95	16-40	NP-15
152B: Milaca-----	0-3	Fine sandy loam	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	3-22	Fine sandy loam, very fine sandy loam.	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	22-32	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	32-48	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	48-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	80-95	70-90	50-70	25-40	15-22	NP-4

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
152C: Milaca-----	0-3	Fine sandy loam	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	3-15	Fine sandy loam, very fine sandy loam.	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	15-20	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	20-45	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	45-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	80-95	70-90	50-70	25-40	15-22	NP-4
152E: Milaca-----	0-4	Fine sandy loam	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	4-10	Fine sandy loam, very fine sandy loam.	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	10-22	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	22-42	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	42-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	80-95	70-90	50-70	25-40	15-22	NP-4
164B: Mora-----	0-3	Fine sandy loam	SM, ML	A-4	0-1	0-2	90-100	80-98	50-90	30-60	15-20	NP-4
	3-15	Fine sandy loam, sandy loam, loam.	SM, ML	A-4	0-1	0-2	90-100	80-98	50-95	30-75	15-20	NP-4
	15-28	Fine sandy loam, sandy loam, loam.	SM, ML	A-4	0-1	0-2	90-100	80-98	50-95	30-75	15-20	NP-4
	28-42	Fine sandy loam, sandy loam.	SM	A-4, A-2	0-1	0-4	85-100	75-98	50-80	30-50	15-20	NP-4
	42-60	Fine sandy loam, sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-4	85-95	70-90	45-70	25-40	15-20	NP-4

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
166: Ronneby-----	0-4	Loam-----	ML	A-4	0-1	0-5	95-100	80-95	75-95	50-75	15-25	NP-4
	4-22	Sandy loam, fine sandy loam, loam.	SM, ML	A-4	0-1	0-5	85-100	80-95	60-85	35-65	15-25	NP-4
	22-35	Fine sandy loam, sandy loam, loam.	SM, ML, SC-SM, CL-ML	A-4	0-1	0-5	85-95	75-95	60-85	35-60	20-30	2-7
	35-45	Sandy loam, fine sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	75-95	60-80	25-50	15-20	NP-4
	45-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	70-90	60-80	25-50	15-20	NP-4
167B: Baudette-----	0-4	Silt loam-----	ML	A-4	0	0	100	100	95-100	60-90	20-40	1-10
	4-13	Very fine sandy loam, fine sandy loam, silt loam.	SM, ML	A-4	0	0	100	100	75-100	40-90	15-40	NP-10
	13-35	Clay loam, silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	20-50	5-20
	35-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML	A-4	0	0	100	100	95-100	70-100	20-40	1-10
186: Nemadji-----	0-11	Loamy fine sand	SM, SP-SM	A-4, A-2	0	0	100	100	75-95	10-45	---	NP
	11-34	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-3, A-4, A-2	0	0	100	100	55-95	5-45	---	NP
	34-60	Fine sand, sand	SP-SM, SP	A-3	0	0	100	100	55-95	2-10	---	NP
188B: Omega-----	0-11	Loamy fine sand	SM, SP-SM, SC-SM	A-2, A-3	0	0	100	90-100	70-90	5-20	15-20	NP-5
	11-60	Sand, fine sand	SP, SP-SM	A-3	0	0	100	90-100	70-90	2-10	---	NP
188C: Omega-----	0-16	Loamy fine sand	SM, SP-SM, SC-SM	A-2, A-3	0	0	100	90-100	70-90	5-20	15-20	NP-5
	16-60	Sand, fine sand	SP, SP-SM	A-3	0	0	100	90-100	70-90	2-10	---	NP
188E: Omega-----	0-5	Loamy sand-----	SM, SP-SM, SC-SM	A-2, A-3	0	0	100	90-100	70-90	5-20	15-20	NP-5
	5-60	Sand, fine sand	SP, SP-SM	A-3	0	0	100	90-100	70-90	2-10	---	NP

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
202: Meehan-----	In											
	0-7	Loamy sand----	SM	A-2, A-1	0	0	90-100	75-100	40-90	15-30	0-14	NP
	7-28	Sand, loamy sand, loamy coarse sand.	SM, SP, SP-SM	A-1, A-2, A-3	0	0	90-100	75-100	40-90	3-30	0-14	NP
	28-60	Sand, coarse sand.	SP, SP-SM	A-1, A-3, A-2	0	0	90-100	75-100	40-90	0-5	0-14	NP
204B: Branstad-----												
	0-2	Loam-----	CL, ML	A-4	0	0-9	80-100	75-98	55-95	45-80	15-28	NP-9
	2-17	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4, A-2-4	0	0-9	80-100	75-98	45-95	20-80	0-26	NP-8
	17-36	Fine sandy loam, sandy clay loam, loam.	SC, CL, SC-SM, CL-ML	A-6, A-4, A-2-4, A-2-6	0	0-9	80-100	75-98	45-90	20-65	23-35	6-15
	36-43	Sandy clay loam, fine sandy loam, loam.	SC, CL	A-6, A-4, A-2-4, A-2-6	0	0-9	80-100	75-98	50-90	30-70	28-35	9-15
	43-60	Fine sandy loam, loam.	SC, SC-SM, CL, CL-ML	A-4, A-2-4	0	0-9	80-100	75-98	45-90	20-60	23-28	6-9
204C: Cushing-----												
	0-12	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	0-28	3-9
	12-25	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	0-23	NP-6
	25-44	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	44-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	0-34	2-20
204E: Cushing-----												
	0-5	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	0-28	3-9
	5-15	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	0-23	NP-6
	15-29	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	29-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	0-34	2-20

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
218: Watab-----	0-7	Fine sand-----	SM, SP-SM	A-1-b, A-2-4	0	0	100	95-100	45-70	10-25	15-20	NP
	7-28	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-3, A-1-b, A-2-4	0	0	95-100	95-100	10-90	5-35	15-20	NP
	28-36	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-10	80-95	70-90	50-85	25-50	15-20	1-5
	36-54	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-10	80-95	70-90	50-85	25-50	15-20	1-5
	54-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM	A-2-4, A-4	0	0-5	80-95	70-90	50-85	25-50	15-20	1-5
240B: Warba-----	0-14	Very fine sandy loam.	ML, SM	A-4	0	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	14-46	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	0	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	46-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0	0-3	90-100	85-100	70-80	55-75	30-50	10-25
240C: Warba-----	0-11	Very fine sandy loam.	ML, SM	A-4	0	0-1	95-100	95-100	85-95	40-75	20-40	NP-10
	11-42	Clay loam, loam, sandy clay loam.	CL	A-7, A-6	0	0-3	95-100	85-100	75-85	60-80	30-50	15-25
	42-60	Loam, sandy clay loam, clay loam.	CL	A-6, A-7	0	0-3	90-100	85-100	70-80	55-75	30-50	10-25
243: Stuntz-----	0-7	Very fine sandy sandy loam.	ML, SM, CL-ML, SC-SM	A-4	0	0-3	98-100	95-100	85-95	45-75	15-25	NP-6
	7-37	Sandy clay loam, clay loam, loam.	CL	A-7, A-6	0	0-3	95-100	85-97	70-85	50-80	30-50	15-25
	37-60	Loam, sandy clay loam, clay loam.	CL, ML	A-6, A-7	0	0-5	90-100	85-97	65-85	50-75	30-50	10-20

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
266: Freer-----	0-6	Silt loam-----	ML, CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	90-100	80-100	25-40	5-12
	6-21	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	0-5	95-100	90-100	90-100	80-100	15-30	1-10
	21-27	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	90-100	80-100	25-40	5-12
	27-35	Loam, fine sandy loam, sandy loam.	CL-ML, CL	A-4, A-6	0-1	1-10	90-100	80-95	60-90	50-65	25-35	4-12
	35-47	Sandy loam, fine sandy loam.	SM	A-2, A-4	0-1	1-10	90-100	80-95	50-85	25-50	15-20	NP-4
	47-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0-1	1-10	80-95	70-90	50-80	25-50	15-20	NP-4
268B: Cromwell-----	0-23	Fine sandy loam	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	23-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
268C: Cromwell-----	0-20	Sandy loam-----	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	20-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
268E: Cromwell-----	0-15	Fine sandy loam	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	15-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP
268F: Cromwell-----	0-18	Fine sandy loam	SM	A-4, A-2	0	0	95-100	80-100	55-85	20-45	15-20	NP
	18-60	Sand, coarse sand, gravelly sand.	SM, SP, SP-SM	A-1, A-3, A-2	0	0-2	80-100	60-100	35-70	0-15	15-20	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
292: Alstad-----	0-4	Loam-----	CL, ML	A-4	0	0-9	80-100	75-98	55-95	45-85	15-28	NP-9
	4-14	Fine sandy loam, loam, silt loam.	ML, CL, SM, SC	A-4, A-2-4	0	0-9	80-100	75-98	45-90	20-65	0-26	NP-8
	14-22	Fine sandy loam, sandy clay loam, loam.	CL, CL-ML, SC, SC-SM	A-4, A-6, A-2-4, A-2-6	0	0-9	80-100	75-98	45-90	20-65	23-35	6-15
	22-52	Sandy clay loam, fine sandy loam, loam.	CL, SC	A-6, A-4, A-2-4, A-2-6	0	0-9	80-100	75-98	50-90	30-70	28-35	9-15
	52-60	Fine sandy loam, loam.	SC, SC-SM, CL, CL-ML	A-4, A-2-4	0	0-9	80-100	75-98	45-90	20-60	23-28	6-9
302B: Rosholt-----	0-9	Fine sandy loam	SM	A-2, A-4	0	0-3	80-100	75-100	45-90	20-50	0-21	NP-4
	9-15	Fine sandy loam, gravelly loamy sand, silt loam.	SM, ML, SC-SM, CL-ML	A-2, A-4, A-1	0-1	0-3	55-100	50-100	20-100	7-90	0-23	NP-6
	15-22	Fine sandy loam, sandy loam, gravelly loam.	SC, SM, CL, ML	A-2, A-4, A-1	0-1	0-3	55-100	50-100	30-95	15-80	0-26	NP-8
	22-30	Gravelly loamy sand, extremely gravelly coarse sand, sand.	SM, GM, SP-SM, GP-GM	A-1, A-2, A-3	0-5	0-25	30-100	25-100	15-75	8-35	0-23	NP-6
	30-60	Stratified extremely gravelly sand to coarse sand.	GP, SP, SM, GM	A-1, A-2, A-3	0-5	0-25	30-100	25-100	7-70	1-25	0-14	NP
302C: Rosholt-----	0-2	Fine sandy loam	SM	A-2, A-4	0	0-3	80-100	75-100	45-90	20-50	0-21	NP-4
	2-14	Fine sandy loam, gravelly loamy sand, silt loam.	SM, ML, SC-SM, CL-ML	A-2, A-4, A-1	0-1	0-3	55-100	50-100	20-100	7-90	0-23	NP-6
	14-26	Fine sandy loam, sandy loam, gravelly loam.	SC, SM, CL, ML	A-2, A-4, A-1	0-1	0-3	55-100	50-100	30-95	15-80	0-26	NP-8
	26-31	Gravelly loamy sand, extremely gravelly coarse sand, sand.	SM, GM, SP-SM, GP-GM	A-1, A-2, A-3	0-5	0-25	30-100	25-100	15-75	8-35	0-23	NP-6
	31-60	Stratified extremely gravelly sand to coarse sand.	GP, SP, SM, GM	A-1, A-2, A-3	0-5	0-25	30-100	25-100	7-70	1-25	0-14	NP

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
346:												
Talmoon-----	0-10	Fine sandy loam	CL, ML, SM, SC	A-4	0	0-2	95-100	85-100	50-95	35-65	15-26	NP-8
	10-17	Very fine sandy loam, sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	0-2	95-100	85-100	60-95	35-75	23-35	6-15
	17-31	Clay loam, silty clay loam, loam.	CL, ML	A-6, A-7, A-4	0	0-2	95-100	85-100	70-100	50-95	30-50	9-20
	31-60	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC, SC-SM	A-6, A-4, A-7	0	0-2	95-100	85-100	75-100	45-80	25-45	6-18
428:												
Hassman-----	0-4	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	4-8	Mucky silty clay loam, silty clay loam, silt loam.	CL, ML, OL	A-6, A-7	0	0	100	100	90-100	80-90	25-45	10-25
	8-45	Silty clay, clay, silty clay loam.	CL, CH, MH	A-7	0	0	100	100	90-100	85-100	40-65	20-45
	45-60	Silty clay loam, silty clay, clay.	CL, MH, CH, ML	A-6, A-7	0	0	100	100	90-100	85-100	35-65	15-45
454B:												
Mahtomedi-----	0-3	Loamy coarse sand.	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	3-6	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	6-28	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	28-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
454C:												
Mahtomedi-----	0-4	Loamy coarse sand.	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	4-17	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	17-38	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	38-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
454E: Mahtomedi-----	0-1	Loamy coarse sand.	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	1-14	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	14-25	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	25-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
454F: Mahtomedi-----	0-2	Gravelly loamy sand.	SM, SC-SM	A-2, A-1	0	0-2	80-95	50-75	20-40	10-20	15-20	NP-5
	2-15	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	15-30	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	30-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
458B: Menahga-----	0-14	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	14-25	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
458C: Menahga-----	0-4	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	4-23	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	23-60	Coarse sand, sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
458E: Menahga-----	0-10	Loamy sand-----	SM, SP-SM	A-2	0	0	100	85-100	60-80	10-30	---	NP
	10-25	Coarse sand, sand, loamy coarse sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP
	25-60	Coarse sand, sand.	SP, SP-SM	A-3, A-2, A-1	0	0	100	80-100	30-75	0-10	---	NP

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
464B: Brennyville-----	0-5	Silt loam-----	ML, CL, CL-ML	A-4	0-3	0-1	95-100	95-100	90-100	80-90	15-25	2-18
	5-18	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	0-1	95-100	95-100	90-100	80-90	15-25	1-8
	18-24	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	0-1	95-100	95-100	90-100	80-90	15-25	1-8
	24-32	Sandy loam, fine sandy loam, loam.	SM, SC-SM	A-2, A-4	0-1	0-3	85-95	80-90	55-75	40-50	15-22	1-6
	32-38	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0-1	0-3	85-95	80-90	50-70	25-50	15-22	NP-6
	38-60	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0-1	0-3	85-95	80-90	50-70	25-50	15-22	NP-6
469B: Hillcity-----	0-6	Silt loam-----	ML, CL-ML	A-4	0	0	100	100	95-100	85-98	15-25	NP-5
	6-20	Silt loam, very fine sandy loam.	ML, CL-ML	A-4	0	0	100	100	95-100	85-98	15-25	NP-5
	20-43	Silt loam, loam, very fine sandy loam.	CL, CL-ML, ML	A-4	0	0	100	98-100	95-100	85-98	15-30	4-10
	43-60	Loam, silt loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2-4	0	0-2	95-100	80-100	50-85	35-75	20-35	5-15
502: Dusler-----	0-5	Silt loam-----	ML, CL, CL-ML	A-4	0-1	0-2	95-100	90-99	85-95	55-85	21-30	4-11
	5-21	Silt loam, loam, fine sandy loam.	ML, SM, CL, SC	A-4	0-1	0-2	95-100	90-99	80-95	50-85	15-30	NP-10
	21-50	Loam, clay loam	CL, ML	A-6	0-1	0-2	95-100	90-99	85-98	60-90	32-43	13-21
	50-60	Loam, clay loam	CL, ML	A-4, A-6	0-1	0-2	95-100	90-99	80-95	60-90	30-41	11-20
504B: Duluth-----	0-11	Fine sandy loam	ML, SM, CL-ML	A-4	0-1	0-2	95-100	95-99	80-95	40-80	15-25	NP-7
	11-41	Clay loam, loam, silty clay loam.	CL	A-6	0-1	0-2	95-100	90-99	85-98	65-90	32-43	12-21
	41-60	Loam, clay loam, silty clay loam.	CL	A-6	0-1	0-2	90-100	90-99	80-95	65-90	30-40	10-20
504C: Duluth-----	0-12	Fine sandy loam	ML, SM, CL-ML	A-4	0-1	0-2	95-100	95-99	80-95	40-80	15-25	NP-7
	12-49	Clay loam, loam	CL	A-6	0-1	0-2	95-100	90-99	85-98	65-90	32-43	12-21
	49-60	Loam, clay loam	CL	A-6	0-1	0-2	90-100	90-99	80-95	65-90	30-40	10-20

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
504E:												
Duluth-----	0-14	Fine sandy loam	ML, SM, CL-ML	A-4	0-1	0-2	95-100	95-99	80-95	40-80	15-25	NP-7
	14-37	Clay loam, loam	CL	A-6	0-1	0-2	95-100	90-99	85-98	65-90	32-43	12-21
	37-60	Loam, clay loam	CL	A-6	0-1	0-2	90-100	90-99	80-95	65-90	30-40	10-20
531:												
Beseman-----	0-14	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	14-40	Sapric material	PT	A-8	0	0	0	0	0	0	---	NP
	40-60	Loam, sandy loam.	CL, ML, SM, SC	A-2, A-4, A-6	0	0-2	75-100	65-100	40-95	25-75	15-30	NP-12
532:												
Sago-----	0-11	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	11-60	Stratified fine sand to silt loam.	SM, ML, CL, SC	A-4, A-2	0	0	98-100	95-100	70-95	15-85	15-30	2-9
533:												
Loxley-----	0-3	Peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	3-60	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
540:												
Seelyeville----	0-9	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	9-60	Muck, mucky peat.	PT	A-8	0	0	0	0	0	0	---	NP
541:												
Rifle-----	0-10	Peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	10-60	Mucky peat----	PT	A-8	0	0	0	0	0	0	---	NP
543:												
Markey-----	0-35	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	35-60	Fine sand, loamy sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	0	100	75-100	60-75	0-20	0-14	NP
544:												
Cathro-----	0-20	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	20-38	Sapric material	PT	A-8	0	0	0	0	0	0	---	NP
	38-60	Sandy loam, loam, clay loam.	CL-ML, SC-SM, SC, CL	A-4, A-6	0	0-5	85-100	75-100	60-100	35-90	20-40	5-20
546:												
Lupton-----	0-13	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	13-60	Sapric material	PT	A-8	0	0	0	0	0	0	---	NP
549:												
Greenwood-----	0-14	Peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	14-60	Hemic material, mucky peat.	PT	A-8	0	0	0	0	0	0	---	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
563: Northwood-----	0-9	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	9-13	Fine sandy loam, loamy fine sand, loamy sand.	SM, SC-SM	A-2, A-4	0	0-3	95-100	90-100	51-85	15-50	0-35	NP-10
	13-35	Coarse sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	0-3	95-100	80-100	70-95	5-35	0-14	NP
	35-60	Loam, clay loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0-3	95-100	90-100	75-100	50-80	20-40	3-20
564: Friendship-----	0-3	Loamy sand-----	SM, SP-SM	A-1, A-2	0	0	75-100	75-100	40-75	12-30	0-14	NP
	3-6	Sand, loamy sand, coarse sand.	SP-SM, SM, SP	A-1, A-2, A-3	0	0	75-100	75-100	40-75	3-30	0-14	NP
	6-39	Sand, coarse sand.	SP-SM, SM, SP	A-1, A-3, A-2	0	0	75-100	75-100	40-70	3-15	0-14	NP
	39-60	Sand, coarse sand.	SP-SM, SM, SP	A-1, A-3, A-2	0	0	75-100	75-100	40-70	3-15	0-14	NP
607: Pengilly-----	0-4	Silt loam-----	CL, CL-ML	A-4	0	0	95-100	90-100	80-100	60-90	20-30	5-10
	4-60	Stratified loamy very fine sand to silt loam.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	0	95-100	90-100	60-95	30-75	15-20	NP-7
615: Cowhorn-----	0-7	Loamy very fine sand.	ML, SM	A-4	0	0	100	100	75-100	35-60	15-25	NP-4
	7-39	Loamy very fine sand, very fine sand.	SM, ML	A-4	0	0	100	100	75-100	35-60	15-25	NP-4
	39-60	Very fine sand, loamy very fine sand.	SM, ML	A-4	0	0	100	100	75-100	35-60	15-25	NP-4
617B: Goodland-----	0-12	Silt loam-----	ML, CL-ML	A-4	0	0	95-100	95-100	85-100	50-90	15-25	2-5
	12-24	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4	0	0-3	95-100	85-95	45-75	35-60	20-30	2-10
	24-33	Gravelly loamy coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SC-SM	A-2, A-1	0	0-10	70-100	65-100	35-50	5-30	15-20	NP-5
	33-60	Sand, gravelly coarse sand, gravelly sand.	SP, SW, SP-SM	A-1	0	0-10	80-100	75-100	35-50	2-10	---	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
618B: Itasca-----	0-11	Silt loam-----	ML, CL-ML	A-4	0	0	100	100	90-100	70-95	15-25	NP-5
	11-21	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4	0	0	95-100	95-100	80-100	45-90	15-25	NP-5
	21-28	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
	28-60	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
621: Morph-----	0-13	Very fine sandy loam.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	0	100	95-100	60-95	30-70	15-25	NP-5
	13-33	Loam, fine sandy loam, clay loam.	ML, CL, SM, SC	A-4	0	0	100	95-100	60-100	35-90	20-30	3-9
	33-60	Stratified loamy sand to silty clay loam.	SM, SC, CL, ML	A-4, A-2	0	0	100	95-100	60-100	30-90	15-25	2-8
625: Sandwick-----	0-6	Loamy sand-----	SM	A-2	0	0	95-100	85-100	65-90	15-30	0-14	NP
	6-34	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2	0	0	95-100	85-100	60-90	10-30	0-14	NP
	34-55	Loam, clay loam, sandy loam.	CL, ML	A-6, A-7	0	0-5	90-100	85-100	70-90	55-80	30-45	10-20
	55-60	Loam, clay loam, sandy loam.	CL, ML	A-6	0	0-5	90-100	85-100	70-90	50-80	30-40	10-20
627: Tawas-----	0-13	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	13-31	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	31-60	Sand, loamy fine sand, gravelly sand.	SP, SM, SP-SM	A-3, A-2-4, A-4, A-1-b	0	0	80-100	60-100	30-80	0-40	0-14	NP
628: Talmoon-----	0-4	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	4-20	Very fine sandy loam, sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	0-2	95-100	85-100	60-95	35-75	23-35	6-15
	20-42	Clay loam, silty clay loam, loam.	CL, ML	A-6, A-7, A-4	0	0-2	95-100	85-100	70-100	50-95	30-50	9-20
	42-60	Loam, sandy clay loam, clay loam.	CL, SC, CL-ML, SC-SM	A-6, A-4, A-7	0	0-2	95-100	85-100	75-100	45-80	25-45	6-18

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
629B: Wawina-----	0-23	Loamy very fine sand.	SM, ML	A-4, A-2	0	0	100	100	95-100	30-60	---	NP
	23-60	Very fine sand, loamy very fine sand.	SM, ML	A-4, A-2	0	0	100	100	75-100	20-60	---	NP
672: Willossippi-----	0-7	Loam-----	ML, CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-90	15-35	4-15
	7-12	Fine sandy loam, loam, silt loam.	SM, ML, CL-ML, SC-SM	A-4, A-6	0	0	100	100	70-95	40-90	15-35	NP-15
	12-42	Stratified silty clay loam to loamy sand.	ML, CL	A-6	0	0	100	100	50-90	20-90	25-40	10-20
	42-60	Stratified silty clay loam to loamy sand.	ML, CL, CL-ML, SC-SM	A-4, A-6	0	0	100	100	50-90	20-90	15-40	4-15
685: Oesterle-----	0-10	Fine sandy loam	SM, SC, SC-SM	A-2, A-4, A-1	0	0-9	80-100	75-100	45-90	20-50	18-26	3-8
	10-21	Sandy loam, loam.	ML, CL, SM, SC	A-2, A-4, A-1	0	0-9	75-100	70-100	40-95	20-75	18-26	3-8
	21-34	Sandy loam, gravelly loam.	SM, SC, CL, ML	A-2, A-1, A-4	0	0-9	55-100	50-100	25-95	15-60	0-28	NP-9
	34-60	Gravelly sand, loamy sand.	SM, SP, GM, GP	A-1, A-3, A-2	0	0-9	30-100	25-100	7-75	1-35	0-14	NP
732B: Bushville-----	0-11	Loamy fine sand	SM	A-2-4	0	0	100	95-100	55-70	15-30	---	NP
	11-26	Fine sand, sand, loamy fine sand.	SM, SP-SM	A-2-4	0	0	100	95-100	55-85	10-25	---	NP
	26-31	Fine sandy loam, sandy loam.	SC-SM, SC	A-4	0-2	0-3	85-95	80-95	55-75	40-50	15-22	4-9
	31-50	Sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2-4	0-2	0-3	85-95	80-95	50-70	25-50	15-22	NP-6
	50-60	Sandy loam, fine sandy loam.	SM, SC-SM	A-4, A-2-4	0-2	0-3	85-95	80-95	50-70	25-50	15-22	NP-6
734: Cormant-----	0-8	Loamy fine sand	SM, SP-SM	A-2, A-4, A-3	0	0	100	100	80-100	5-40	---	NP
	8-60	Stratified sand to silty clay loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	0	100	100	60-95	30-75	15-25	NP-6

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
736:												
Ronneby-----	0-5	Fine sandy loam	SM	A-4	0-1	0-5	95-100	80-95	60-95	35-50	15-25	NP-4
	5-28	Sandy loam, fine sandy loam, loam.	SM, ML	A-4	0-1	0-5	85-100	80-95	60-85	35-65	15-25	NP-4
	28-37	Fine sandy loam, sandy loam, loam.	SM, ML, SC-SM, CL-ML	A-4	0-1	0-5	85-95	75-95	60-85	35-60	20-30	2-7
	37-46	Sandy loam, fine sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	75-95	60-80	25-50	15-20	NP-4
	46-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-5	85-95	70-90	60-80	25-50	15-20	NP-4
Mora-----	0-3	Fine sandy loam	SM, ML	A-4	0-1	0-2	90-100	80-98	50-90	30-60	15-20	NP-4
	3-7	Fine sandy loam, sandy loam, loam.	SM, ML	A-4	0-1	0-2	90-100	80-98	50-95	30-75	15-20	NP-4
	7-25	Fine sandy loam, sandy loam, loam.	SM, ML	A-4	0-1	0-2	90-100	80-98	50-95	30-75	15-20	NP-4
	25-43	Fine sandy loam, sandy loam.	SM	A-4, A-2	0-1	0-4	85-100	75-98	50-80	30-50	15-20	NP-4
	43-60	Fine sandy loam, sandy loam, gravelly sandy loam.	SM	A-4, A-2	0-1	0-4	85-95	70-90	45-70	25-40	15-20	NP-4
738B:												
Milaca-----	0-4	Fine sandy loam	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	4-17	Fine sandy loam, very fine sandy loam.	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	17-22	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	22-33	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	33-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	80-95	70-90	50-70	25-40	15-22	NP-4
Millward-----	0-4	Fine sandy loam	SM	A-4, A-2-4	0-1	0-2	95-100	80-100	55-85	25-65	0-22	NP-4
	4-21	Sandy loam, fine sandy loam, loam.	SM	A-4, A-2-4	0-1	0-2	95-100	80-100	50-70	25-60	0-22	NP-4
	21-34	Sand, coarse sand, loamy sand.	SM, SP, SP-SM	A-1-b, A-3, A-2-4	0-1	0-2	80-100	60-100	35-70	5-30	0-20	NP
	34-46	Sandy loam, fine sandy loam, loam.	SM	A-4, A-2-4	0-1	0-5	85-95	75-95	50-70	30-40	0-22	NP-4
	46-60	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0-1	0-5	80-95	70-90	50-70	30-40	0-22	NP-4

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
738C:												
Milaca-----	0-3	Sandy loam-----	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	3-14	Fine sandy loam, very fine sandy loam.	SM	A-4	0	0-2	90-100	80-100	60-80	35-50	15-22	NP-4
	14-21	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	21-32	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	0-5	85-95	75-95	50-70	30-40	15-22	NP-4
	32-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4	0	0-5	80-95	70-90	50-70	25-40	15-22	NP-4
Millward-----	0-8	Fine sandy loam	SM	A-4, A-2-4	0-1	0-2	95-100	80-100	55-85	25-65	0-22	NP-4
	8-23	Sandy loam, fine sandy loam, loam.	SM	A-4, A-2-4	0-1	0-2	95-100	80-100	50-70	25-60	0-22	NP-4
	23-34	Sand, coarse sand, loamy sand.	SM, SP, SP-SM	A-1-b, A-3, A-2-4	0-1	0-2	80-100	60-100	35-70	5-30	0-20	NP
	34-43	Sandy loam, fine sandy loam, loam.	SM	A-4, A-2-4	0-1	0-5	85-95	75-95	50-70	30-40	0-22	NP-4
	43-60	Sandy loam, fine sandy loam, loam.	SM	A-2, A-4	0-1	0-5	80-95	70-90	50-70	30-40	0-22	NP-4
759:												
Waukenabo-----	0-6	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2-4, A-4	0	0	100	98-100	70-95	35-70	15-30	NP-10
	6-15	Loamy fine sand, loamy sand.	SM, SC-SM	A-2-4, A-4	0	0	100	98-100	60-90	10-40	15-25	NP-6
	15-28	Clay loam, loam, sandy loam.	SC-SM, CL-ML, ML, CL	A-2-4, A-4, A-6	0	0	100	98-100	70-95	30-75	15-30	2-10
	28-30	Sandy loam, very fine sandy loam, clay loam.	SC-SM, CL-ML, ML, CL	A-2-4, A-4, A-6	0	0	100	98-100	70-95	30-75	15-30	2-10
	30-60	Stratified fine sand to clay loam.	SC-SM, CL-ML, ML, CL	A-2-4	0	0	100	98-100	60-95	30-75	15-25	NP-6
795:												
Redby-----	0-7	Loamy fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	85-95	5-25	---	NP
	7-25	Fine sand, sand	SM, SP-SM	A-3, A-2	0	0	100	95-100	80-95	5-20	---	NP
	25-42	Fine sand, sand	SP, SP-SM	A-3, A-2	0	0	100	95-100	80-95	2-12	---	NP
	42-60	Stratified fine sand to fine sandy loam.	SP-SM	A-3	0	0	100	95-100	80-95	5-20	---	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
797: Mooselake-----	0-60	Mucky peat-----	PT	A-8	0	0	0	0	0	0	---	NP
Lupton-----	0-8	Mucky peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	8-60	Sapric material	PT	A-8	0	0	0	0	0	0	---	NP
798: Sago-----	0-13	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	13-60	Stratified fine sand to silt loam.	SM, ML, CL, SC	A-4, A-2	0	0	98-100	95-100	70-95	15-85	15-30	2-9
Roscommon-----	0-6	Mucky loamy sand.	SM, SP-SM, SC-SM	A-2, A-1-b	0	0	95-100	85-100	40-85	10-35	0-23	NP-6
	6-60	Sand, loamy sand, coarse sand.	SP, SM, SP-SM	A-1, A-2, A-3	0	0	95-100	85-100	40-75	0-30	0-20	NP-4
799: Seelyeville-----	0-28	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	28-60	Muck, sapric material.	PT	A-8	0	0	0	0	0	0	---	NP
Bowstring-----	0-38	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	38-43	Stratified sand to fine sandy loam.	SP-SM, SM, SC-SM	A-2	0	0	100	100	50-85	10-35	15-20	NP-5
	43-60	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
869: Lobo-----	0-44	Peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	44-60	Hemic material	PT	A-8	0	0	0	0	0	0	---	NP
Waskish-----	0-60	Peat-----	PT	A-8	0	0	0	0	0	0	---	NP
870B: Itasca-----	0-12	Silt loam-----	ML, CL-ML	A-4	0	0	100	100	90-100	70-95	15-25	NP-5
	12-16	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4	0	0	95-100	95-100	80-100	45-90	15-25	NP-5
	16-37	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
	37-60	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	<u>In</u>				<u>Pct</u>	<u>Pct</u>					<u>Pct</u>	
870B: Goodland-----	0-13	Silt loam-----	ML, CL-ML	A-4	0	0	95-100	95-100	85-100	50-90	15-25	2-5
	13-30	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4	0	0-3	95-100	85-95	45-75	35-60	20-30	2-10
	30-41	Gravelly loamy coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SC-SM	A-2, A-1	0	0-10	70-100	65-100	35-50	5-30	15-20	NP-5
	41-60	Sand, gravelly coarse sand, gravelly sand.	SP, SW, SP-SM	A-1	0	0-10	80-100	75-100	35-50	2-10	---	NP
870C: Itasca-----	0-4	Silt loam-----	ML, CL-ML	A-4	0	0	100	100	90-100	70-95	15-25	NP-5
	4-14	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4	0	0	95-100	95-100	80-100	45-90	15-25	NP-5
	14-49	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
	49-60	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
Goodland-----	0-12	Silt loam-----	ML, CL-ML	A-4	0	0	95-100	95-100	85-100	50-90	15-25	2-5
	12-25	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4	0	0-3	95-100	85-95	45-75	35-60	20-30	2-10
	25-33	Gravelly loamy coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SC-SM	A-2, A-1	0	0-10	70-100	65-100	35-50	5-30	15-20	NP-5
	33-60	Sand, gravelly coarse sand, gravelly sand.	SP, SW, SP-SM	A-1	0	0-10	80-100	75-100	35-50	2-10	---	NP
870E: Itasca-----	0-2	Silt loam-----	ML, CL-ML	A-4	0	0	100	100	90-100	70-95	15-25	NP-5
	2-14	Silt loam, very fine sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4	0	0	95-100	95-100	80-100	45-90	15-25	NP-5
	14-53	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10
	53-60	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-2	0	0-5	90-100	85-100	55-85	25-70	20-30	3-10

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
870E: Goodland-----	0-8	Silt loam-----	ML, CL-ML	A-4	0	0	95-100	95-100	85-100	50-90	15-25	2-5
	8-23	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4	0	0-3	95-100	85-95	45-75	35-60	20-30	2-10
	23-34	Gravelly loamy coarse sand, loamy coarse sand, loamy sand.	SM, SP-SM, SC-SM	A-2, A-1	0	0-10	70-100	65-100	35-50	5-30	15-20	NP-5
	34-60	Sand, gravelly coarse sand, gravelly sand.	SP, SW, SP-SM	A-1	0	0-10	80-100	75-100	35-50	2-10	---	NP
872: Pengilly-----	0-4	Silt loam-----	CL, CL-ML	A-4	0	0	95-100	90-100	80-100	60-90	20-30	5-10
	4-60	Stratified loamy very fine sand to silt loam.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	0	95-100	90-100	60-95	30-75	15-20	NP-7
Winterfield-----	0-6	Loamy fine sand	SM, SC-SM	A-2-4, A-4	0	0	100	95-100	50-90	15-45	0-25	NP-7
	6-41	Coarse sand, loamy sand, loamy fine sand.	SM, SP, SP-SM, SC-SM	A-2-4, A-3, A-4	0	0	100	95-100	50-90	2-45	0-25	NP-7
	41-60	Sand, gravelly sand, loamy fine sand.	SM, SP-SM, SP	A-3, A-1-b, A-2-4	0	0	85-100	70-100	35-80	0-35	0-14	NP
928C: Cushing-----	0-16	Very fine sandy loam.	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0	0-7	75-100	75-100	45-95	20-65	0-25	2-7
	16-19	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	0-23	NP-6
	19-44	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	44-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	0-34	2-20
Mahtomedi-----	0-4	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	4-15	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	15-26	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	26-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
928D: Cushing-----	0-7	Loam-----	CL, ML, SC, SM	A-4	0	0-7	75-100	75-100	65-100	45-100	0-28	3-9
	7-17	Loam, silt loam, sandy loam.	SM, SC-SM, ML, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	0-23	NP-6
	17-30	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	30-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	0-34	2-20
Mahtomedi-----	0-3	Loamy coarse sand.	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	3-13	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	13-25	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	25-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP
928F: Cushing-----	0-4	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2, A-1	0	0-7	75-100	75-100	45-95	20-65	0-25	2-7
	4-14	Loam, silt loam, sandy loam.	SM, ML, SC-SM, CL-ML	A-2, A-4, A-1	0	0-7	75-100	75-100	35-100	12-90	0-23	NP-6
	14-35	Loam, sandy clay loam, sandy loam.	SC	A-2, A-4, A-6, A-7	0	0-7	75-100	75-100	45-95	20-50	25-45	9-27
	35-60	Loam, sandy clay loam, sandy loam.	SC, SM, SC-SM	A-2, A-4, A-6, A-1	0	0-7	75-100	75-100	45-95	20-50	0-34	2-20
Mahtomedi-----	0-4	Loamy sand-----	SM, SC-SM	A-2, A-1	0	0-2	95-100	75-90	40-85	15-30	15-20	NP-4
	4-20	Sand, coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	0-2	80-95	75-90	30-75	5-15	15-20	NP
	20-35	Sand, coarse sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0	0-10	70-95	50-90	30-75	5-15	15-20	NP
	35-60	Sand, coarse sand, gravelly sand.	SP, SM, SP-SM	A-2, A-3, A-1	0	0-10	55-95	50-90	30-70	2-15	15-20	NP

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
980:												
Blackhoof-----	0-10	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	10-14	Silty clay loam, silt loam, clay loam.	CL, ML, CL-ML	A-4, A-6	0-1	0-2	95-100	90-99	85-95	65-95	30-43	11-21
	14-60	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0-1	0-2	95-100	85-99	80-95	65-95	30-43	11-21
Mahtowa-----	0-3	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	3-11	Loam, silt loam, clay loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	0-2	95-100	85-100	80-95	50-80	25-45	5-20
	11-60	Loam, clay loam	CL, ML, CL-ML	A-4, A-6, A-7	0	0-2	95-100	85-100	80-95	50-80	25-45	5-20
990:												
Twig-----	0-10	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	10-16	Mucky silt loam, silt loam, loam.	OL, CL, CL-ML	A-4	0	0	100	100	85-95	60-85	15-25	NP-10
	16-44	Loam, silt loam, fine sandy loam.	ML	A-4	0-1	0-2	90-100	90-100	80-90	50-65	15-25	NP-2
	44-52	Fine sandy loam, loam, sandy loam.	SM	A-2, A-4	0-1	0-4	85-100	80-95	70-90	30-45	15-25	NP-2
	52-60	Fine sandy loam, loam, sandy loam.	SM	A-2, A-4	0-1	0-4	85-100	80-95	70-90	30-45	15-25	NP-2
Giese-----	0-4	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	4-10	Loam, silt loam, fine sandy loam.	ML, CL, CL-ML, SM	A-2, A-4, A-6	0-1	0-2	90-100	75-95	55-90	25-85	10-40	NP-15
	10-21	Fine sandy loam, loamy fine sand, sandy loam.	SM, SC-SM	A-2, A-4, A-6	0-1	0-5	85-95	75-95	55-75	30-55	0-20	NP-5
	21-43	Sandy clay loam, fine sandy loam, loam.	SM	A-4, A-2, A-6	0-1	0-5	80-95	75-95	50-75	30-55	0-20	NP-10
	43-70	Fine sandy loam, sandy loam.	SM	A-2, A-4	0-1	0-5	80-95	70-90	40-75	25-45	0-20	NP-5
	70-80	Fine sandy loam, sandy loam.	SM, SC-SM	A-2, A-4	0-1	0-5	80-95	70-90	40-75	25-45	0-20	NP-5
1002:												
Borosaprists---	0-27	Muck-----	PT	A-8	0	0	100	95-100	90-100	85-95	0-14	NP
	27-48	Muck-----	PT	A-8	0	0	100	95-100	90-100	85-95	0-14	NP
	48-60	Stratified sand to silt loam.	SM, SC, ML, CL	A-2, A-4, A-7, A-8	0	0	100	100	70-90	15-65	15-35	NP-15

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
1002: Fluvaquents----	0-16	Silt loam-----	ML, SM	A-4	0	0	100	90-100	75-100	45-80	15-35	NP-10
	16-60	Stratified loamy sand to silt loam.	ML, CL, SM, SC	A-2, A-4, A-6, A-7	0	0	95-100	85-100	45-95	20-80	20-45	3-20
1030: Pits.												
Udipsamments----	0-14	Sand-----	SM, SP-SM	A-2	0	0	95-100	85-100	75-90	10-35	---	NP
	14-60	Sand, fine sand	SP-SM, SP	A-2, A-3	0	0	95-100	85-100	50-75	5-25	---	NP
	60-80	Coarse sand, gravelly coarse sand.	SP, SP-SM, GP-GM	A-1, A-2	0	0	75-100	65-85	40-65	1-10	---	NP
1031: Histosols-----	0-40	Mucky peat-----	PT	A-8	0	0	0	0	0	0	---	NP
	40-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	0	100	100	50-90	5-30	---	NP
1072: Udorthents.												
1115: Newson-----	0-6	Loamy sand-----	SM, SP-SM	A-2, A-1	0	0	80-100	75-100	40-85	12-35	0-23	NP-6
	6-23	Loamy sand, sand.	SM, SP, SP-SM	A-2, A-3, A-1	0	0	80-100	75-100	45-75	3-30	0-14	NP
	23-60	Sand, loamy sand.	SM, SP, SP-SM	A-2, A-3, A-1	0	0	80-100	75-100	45-75	3-30	0-14	NP
1150: Jevne-----	0-6	Fine sandy loam	SM, SC, ML, CL	A-4	0-1	0-2	95-100	85-100	50-95	35-65	15-25	2-7
	6-19	Fine sandy loam, sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0-1	0-2	95-100	85-100	60-95	35-75	15-30	2-11
	19-43	Clay loam, loam, silt loam.	CL, ML	A-6, A-7, A-4	0-1	0-2	95-100	85-100	70-100	45-80	30-50	9-20
	43-60	Stratified clay loam to loamy sand.	ML, CL, CL-ML, SC-SM	A-4, A-6	0-1	0-2	95-100	85-100	70-90	30-60	15-40	6-15
1154: Sax-----	0-12	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	12-15	Mucky silt loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-85	20-40	5-15
	15-39	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-85	20-40	5-15
	39-60	Silt loam, silty clay loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	0	100	100	90-100	50-90	16-40	NP-15

## Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
1353B: Cutaway-----	<u>In</u>											
	0-11	Loamy fine sand	SM, SP-SM	A-2	0-3	0	100	85-100	55-90	10-25	---	NP
	11-26	Loamy sand, sand, coarse sand.	SM, SP-SM	A-2, A-3	0-3	0	100	85-100	50-80	5-20	---	NP
	26-49	Loam, clay loam, sandy loam.	CL, ML	A-6, A-7	0-4	0	95-100	85-100	75-85	60-80	30-45	10-20
	49-60	Loam, clay loam, sandy loam.	CL, ML	A-6, A-4	0-4	0	95-100	85-100	70-80	55-70	30-45	10-20
1354A: Aftad-----	0-3	Fine sandy loam	SM	A-4	0	0	95-100	90-100	65-90	35-50	0-18	NP-3
	3-25	Very fine sandy loam, loam, loamy sand.	SM, ML, SC-SM, CL-ML	A-4, A-2-4	0	0	95-100	90-100	45-95	25-80	0-23	NP-6
	25-44	Very fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4	0	0	95-100	90-100	65-95	35-80	18-26	NP-8
	44-60	Stratified sandy loam to silt loam.	SM, ML, SC-SM, CL-ML	A-4, A-2-4	0	0	95-100	90-100	65-95	25-90	0-23	NP-6
1372: Wealthwood-----	0-4	Loamy fine sand	SM	A-2-4	0	0	100	100	80-90	15-30	15-25	NP-7
	4-28	Loamy fine sand, loamy sand, fine sand.	SM, SP, SP-SM	A-1-b, A-2-4	0	0	100	100	70-90	0-30	15-25	NP-7
	28-42	Stratified silty clay loam to sand.	ML, CL	A-6	0	0	100	100	70-90	40-85	20-40	4-20
	42-60	Stratified silt loam to sand.	ML	A-4	0	0	100	100	70-90	15-50	15-30	NP-7
1375B: Alban-----	0-5	Fine sandy loam	ML, SM	A-2, A-4	0	0	95-100	90-100	60-85	30-55	0-20	1-4
	5-23	Loamy sand, fine sandy loam, silt loam.	SM, ML, CL, SC	A-2, A-4	0	0	95-100	90-100	50-100	15-90	0-25	NP-8
	23-29	Fine sandy loam, very fine sandy loam, sandy loam.	SM, SC, ML, CL	A-2, A-4	0	0	95-100	90-100	60-100	30-75	0-25	NP-8
	29-60	Stratified silt to fine sand.	SM, ML, SC-SM, SP-SM	A-4, A-2, A-3	0	0	95-100	90-100	70-100	5-100	0-25	NP-6

Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10	3-10	4	10	40	200		
					inches	inches						
	In				Pct	Pct					Pct	
1878:												
Hamre-----	0-10	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	10-17	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-1	0-3	90-100	80-100	70-100	50-90	25-45	6-20
	17-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0-1	0-3	80-100	75-100	65-95	50-85	25-45	6-20
1982:												
Baudette-----	0-4	Silt loam-----	ML	A-4	0	0	100	100	95-100	60-90	20-40	1-10
	4-9	Very fine sandy loam, fine sandy loam, silt loam.	SM, ML	A-4	0	0	100	100	75-100	40-90	15-40	NP-10
	9-21	Clay loam, silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	20-50	5-20
	21-60	Silt loam, very fine sandy loam, loamy very fine sand.	ML	A-4	0	0	100	100	95-100	70-100	20-40	1-10
Spooner-----	0-7	Silt loam-----	ML	A-4, A-6	0	0	100	100	90-100	50-80	25-40	1-14
	7-22	Loamy very fine sand, very fine sandy loam, loam.	SM, ML, SC, CL	A-4, A-6	0	0	100	100	90-100	35-60	10-40	1-15
	22-27	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	60-85	20-40	5-15
	27-60	Very fine sandy loam, silt loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	0	100	100	90-100	35-95	16-40	NP-15
1983:												
Cathro-----	0-16	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	16-35	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	35-60	Stratified silty clay loam to sand.	ML, CL, CL-ML	A-4, A-6	0	0-1	95-100	90-100	75-95	50-90	15-40	2-20
1984:												
Leafriver-----	0-13	Muck-----	PT	A-8	0	0	0	0	0	0	---	NP
	13-17	Loamy sand, sandy loam, fine sand.	SM	A-4, A-2-4	0	0	100	95-100	55-80	15-40	15-20	NP-4
	17-60	Loamy sand, fine sand, sand.	SM, SP, SP-SM	A-3, A-2, A-2-4, A-1-b	0	0	95-100	80-100	45-70	3-35	---	NP

## Physical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water		Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
					In/hr	In/in			K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct						
72:													
Shooker-----	0-9	5-20	1.25-1.45	2.00-6.00	0.13-0.15	Low-----	2.0-4.0	0.32	0.32	5	3	86	
	9-27	18-35	1.40-1.60	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.32	0.32				
	27-60	12-27	1.40-1.65	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.32	0.32				
119C:													
Pomroy-----	0-4	5-12	1.40-1.50	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	4	2	134	
	4-15	2-10	1.50-1.65	6.00-20.00	0.06-0.09	Low-----	0.0-0.5	0.15	0.15				
	15-22	6-18	1.65-1.75	0.20-0.60	0.00-0.08	Low-----	0.0-0.5	0.24	0.17				
	22-44	5-15	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.24	0.17				
	44-60	5-15	1.80-2.00	0.00-0.60	0.00-0.04	Low-----	0.0-0.5	0.24	0.17				
124:													
Brickton-----	0-11	15-27	1.20-1.40	0.60-2.00	0.22-0.24	Low-----	2.0-4.0	0.43	0.43	5	6	48	
	11-32	35-60	1.25-1.40	0.06-0.60	0.16-0.19	High-----	0.5-1.0	0.32	0.32				
	32-60	28-60	1.30-1.45	0.06-0.60	0.16-0.22	High-----	0.0-0.5	0.32	0.32				
133B:													
Dalbo-----	0-13	5-20	1.30-1.45	2.00-6.00	0.13-0.18	Low-----	1.0-3.0	0.28	0.28	5	3	86	
	13-35	35-60	1.25-1.45	0.06-0.60	0.10-0.18	High-----	0.5-2.0	0.32	0.32				
	35-60	35-60	1.30-1.60	0.20-2.00	0.10-0.18	Moderate	0.0-0.5	0.32	0.32				
142:													
Nokay-----	0-6	4-12	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	3.0-6.0	0.24	0.24	4	3	86	
	6-12	5-15	1.45-1.65	0.60-6.00	0.12-0.19	Low-----	1.0-2.0	0.28	0.28				
	12-19	8-18	1.45-1.65	0.60-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28				
	19-44	4-18	1.65-1.75	0.06-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28				
	44-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28				
144B:													
Flak-----	0-3	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-2.0	0.28	0.28	4	3	86	
	3-13	5-18	1.45-1.70	2.00-6.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28				
	13-22	8-18	1.45-1.80	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28				
	22-45	4-18	1.75-1.90	0.00-0.20	0.00-0.06	Low-----	0.0-0.5	0.28	0.28				
	45-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28				
144C:													
Flak-----	0-2	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-2.0	0.28	0.28	4	3	86	
	2-5	5-18	1.45-1.70	2.00-6.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28				
	5-16	8-18	1.45-1.80	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28				
	16-34	4-18	1.75-1.90	0.00-0.20	0.00-0.06	Low-----	0.0-0.5	0.28	0.28				
	34-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28				
146B:													
Wabedo-----	0-5	8-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-4.0	0.28	0.28	4	3	86	
	5-27	5-18	1.45-1.80	0.60-2.00	0.12-0.16	Low-----	0.5-1.0	0.28	0.28				
	27-47	4-18	1.75-1.90	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.28	0.28				
	47-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28				
147:													
Spooner-----	0-4	10-24	1.25-1.40	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.37	0.37	5	5	56	
	4-10	3-18	1.35-1.55	0.60-6.00	0.17-0.19	Low-----	0.5-1.0	0.37	0.37				
	10-29	18-35	1.30-1.50	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37				
	29-60	5-32	1.40-1.60	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37				

Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
152B: Milaca-----	0-3	8-15	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-1.0	0.28	0.28	4	3	86
	3-22	8-15	1.40-1.60	2.00-6.00	0.18-0.22	Low-----	0.0-0.5	0.28	0.28			
	22-32	8-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28			
	32-48	8-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	48-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
152C: Milaca-----	0-3	8-15	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-1.0	0.28	0.28	4	3	86
	3-15	8-15	1.40-1.60	2.00-6.00	0.18-0.22	Low-----	0.0-0.5	0.28	0.28			
	15-20	8-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28			
	20-45	6-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	45-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
152E: Milaca-----	0-4	8-15	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-1.0	0.28	0.28	4	3	86
	4-10	8-15	1.40-1.60	2.00-6.00	0.18-0.22	Low-----	0.0-0.5	0.28	0.28			
	10-22	8-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28			
	22-42	6-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	42-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
164B: Mora-----	0-3	5-15	1.30-1.60	2.00-6.00	0.15-0.17	Low-----	0.5-3.0	0.28	0.28	4	3	86
	3-15	6-18	1.40-1.70	0.60-6.00	0.14-0.19	Low-----	0.0-0.5	0.28	0.28			
	15-28	8-18	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.28	0.28			
	28-42	6-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	42-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
166: Ronneby-----	0-4	5-18	1.30-1.60	0.60-2.00	0.18-0.23	Low-----	3.0-8.0	0.32	0.32	4	5	56
	4-22	5-18	1.40-1.65	0.60-6.00	0.12-0.19	Low-----	0.5-2.0	0.28	0.28			
	22-35	6-18	1.40-1.65	0.60-2.00	0.12-0.19	Low-----	0.5-1.0	0.28	0.28			
	35-45	4-18	1.65-1.80	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.28	0.28			
	45-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
167B: Baudette-----	0-4	10-27	1.20-1.40	0.60-2.00	0.20-0.22	Low-----	1.0-4.0	0.37	0.37	5	6	48
	4-13	5-27	1.30-1.50	0.60-2.00	0.14-0.20	Low-----	0.5-1.0	0.37	0.37			
	13-35	18-35	1.25-1.45	0.60-2.00	0.17-0.24	Moderate	0.5-1.0	0.37	0.37			
	35-60	5-27	1.30-1.60	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37			
186: Nemadji-----	0-11	2-10	1.45-1.55	6.00-20.00	0.10-0.14	Low-----	0.5-3.0	0.17	0.17	5	2	134
	11-34	1-10	1.55-1.65	6.00-20.00	0.05-0.11	Low-----	0.5-1.0	0.17	0.17			
	34-60	0-5	1.55-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.17	0.17			
188B: Omega-----	0-11	1-10	1.25-1.45	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	11-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.17	0.17			
188C: Omega-----	0-16	1-10	1.25-1.45	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	16-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.17	0.17			
188E: Omega-----	0-5	1-10	1.25-1.45	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	5-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.17	0.17			
202: Meehan-----	0-7	4-10	1.35-1.65	2.00-6.00	0.10-0.12	Low-----	0.5-3.0	0.17	0.17	5	2	134
	7-28	4-9	1.60-1.70	6.00-20.00	0.06-0.11	Low-----	0.0-0.5	0.15	0.15			
	28-60	1-4	1.60-1.70	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.15	0.15			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
204B: Branstad-----	0-2	6-18	1.35-1.55	0.60-2.00	0.16-0.22	Low-----	1.0-3.0	0.32	0.32	5	5	56
	2-17	4-16	1.45-1.65	0.60-2.00	0.09-0.18	Low-----	0.1-1.0	0.24	0.24			
	17-36	13-25	1.55-1.65	0.60-2.00	0.09-0.18	Moderate	0.0-0.5	0.24	0.24			
	36-43	18-27	1.55-1.70	0.60-2.00	0.09-0.18	Moderate	0.0-0.5	0.32	0.32			
	43-60	13-17	1.55-1.80	0.20-2.00	0.09-0.18	Low-----	0.0-0.5	0.28	0.28			
204C: Cushing-----	0-12	6-18	1.35-1.65	0.60-2.00	0.16-0.24	Low-----	1.0-3.0	0.32	0.32	5	5	56
	12-25	4-16	1.55-1.65	0.60-2.00	0.10-0.22	Low-----	0.1-1.0	0.32	0.32			
	25-44	18-35	1.55-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.32	0.32			
	44-60	8-21	1.45-1.80	0.20-0.60	0.09-0.19	Low-----	0.0-0.5	0.32	0.32			
204E: Cushing-----	0-5	6-18	1.35-1.65	0.60-2.00	0.16-0.24	Low-----	1.0-3.0	0.32	0.32	5	5	56
	5-15	4-16	1.55-1.65	0.60-2.00	0.10-0.22	Low-----	0.1-1.0	0.32	0.32			
	15-29	18-35	1.55-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.32	0.32			
	29-60	8-21	1.45-1.80	0.20-0.60	0.09-0.19	Low-----	0.0-0.5	0.32	0.32			
218: Watab-----	0-7	1-8	1.45-1.55	6.00-20.00	0.07-0.10	Low-----	0.5-1.0	0.15	0.15	4	1	220
	7-28	1-10	1.50-1.65	6.00-20.00	0.06-0.09	Low-----	0.0-0.5	0.15	0.15			
	28-36	5-16	1.55-1.65	0.60-6.00	0.08-0.12	Low-----	0.0-0.5	0.28	0.28			
	36-54	6-16	1.65-1.75	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.28	0.28			
	54-60	6-16	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28			
240B: Warba-----	0-14	5-15	1.10-1.40	2.00-6.00	0.18-0.23	Low-----	1.0-3.0	0.20	0.20	5	3	86
	14-46	23-35	1.50-1.70	0.20-0.60	0.16-0.19	Moderate	0.5-1.0	0.32	0.32			
	46-60	20-32	1.50-1.70	0.20-2.00	0.16-0.19	Moderate	0.0-0.5	0.32	0.32			
240C: Warba-----	0-11	5-15	1.10-1.40	2.00-6.00	0.18-0.23	Low-----	1.0-3.0	0.20	0.20	5	3	86
	11-42	23-35	1.50-1.70	0.20-0.60	0.16-0.19	Moderate	0.5-1.0	0.32	0.32			
	42-60	20-32	1.50-1.70	0.20-2.00	0.16-0.19	Moderate	0.0-0.5	0.32	0.32			
243: Stuntz-----	0-7	5-15	1.10-1.40	2.00-6.00	0.18-0.23	Low-----	1.0-3.0	0.28	0.28	5	3	86
	7-37	20-35	1.50-1.70	0.20-0.60	0.16-0.19	Moderate	0.5-1.0	0.28	0.28			
	37-60	20-32	1.50-1.70	0.20-0.60	0.16-0.19	Low-----	0.0-0.5	0.28	0.28			
266: Freer-----	0-6	10-20	1.40-1.60	0.60-2.00	0.20-0.24	Low-----	0.5-2.0	0.37	0.37	4	5	56
	6-21	10-18	1.45-1.65	0.60-2.00	0.18-0.22	Low-----	0.0-0.5	0.37	0.37			
	21-27	18-28	1.40-1.60	0.60-2.00	0.14-0.21	Low-----	0.0-0.5	0.37	0.37			
	27-35	18-28	1.50-1.65	0.60-2.00	0.17-0.19	Low-----	0.0-0.5	0.37	0.37			
	35-47	6-18	1.65-1.75	0.00-0.20	0.03-0.08	Low-----	0.0-0.5	0.28	0.28			
	47-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	---			
268B: Cromwell-----	0-23	5-18	1.20-1.40	0.60-2.00	0.16-0.18	Low-----	0.5-2.0	0.20	0.20	3	3	86
	23-60	0-8	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.15			
268C: Cromwell-----	0-20	5-18	1.20-1.40	0.60-2.00	0.16-0.18	Low-----	0.5-2.0	0.20	0.20	3	3	86
	20-60	0-8	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.15			
268E: Cromwell-----	0-15	5-18	1.20-1.40	0.60-2.00	0.16-0.18	Low-----	0.5-2.0	0.20	0.20	3	3	86
	15-60	0-8	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.15			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
268F: Cromwell-----	0-18	5-18	1.20-1.40	0.60-2.00	0.16-0.18	Low-----	0.5-2.0	0.20	0.20	3	3	86
	18-60	0-8	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.15			
292: Alstad-----	0-4	6-18	1.35-1.55	0.60-2.00	0.16-0.24	Low-----	2.0-5.0	0.32	0.32	5	5	56
	4-14	4-16	1.45-1.65	0.60-2.00	0.09-0.22	Low-----	0.5-1.0	0.24	0.24			
	14-22	13-25	1.55-1.65	0.60-2.00	0.09-0.18	Moderate	0.1-0.8	0.24	0.24			
	22-52	18-27	1.55-1.70	0.60-2.00	0.09-0.18	Moderate	0.0-0.5	0.32	0.32			
	52-60	13-17	1.55-1.80	0.20-2.00	0.09-0.18	Low-----	0.0-0.5	0.28	0.28			
302B: Rosholt-----	0-9	4-10	1.50-1.60	0.60-6.00	0.10-0.18	Low-----	1.0-3.0	0.24	0.24	4	3	86
	9-15	3-12	1.70-1.80	0.60-6.00	0.10-0.22	Low-----	0.0-1.0	0.24	0.24			
	15-22	6-15	1.65-1.75	0.60-6.00	0.09-0.19	Low-----	0.0-0.5	0.24	0.24			
	22-30	4-12	1.55-1.65	0.60-6.00	0.04-0.16	Low-----	0.0-0.5	0.10	0.17			
	30-60	0-5	1.50-1.80	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
302C: Rosholt-----	0-2	4-10	1.50-1.60	0.60-6.00	0.10-0.18	Low-----	1.0-3.0	0.24	0.24	4	3	86
	2-14	3-12	1.70-1.80	0.60-6.00	0.10-0.22	Low-----	0.0-1.0	0.24	0.24			
	14-26	6-15	1.65-1.75	0.60-6.00	0.09-0.19	Low-----	0.0-0.5	0.24	0.24			
	26-31	4-12	1.55-1.65	0.60-6.00	0.04-0.16	Low-----	0.0-0.5	0.10	0.17			
	31-60	0-5	1.50-1.80	6.00-20.00	0.02-0.04	Low-----	0.0-0.5	0.10	0.10			
346: Talmoon-----	0-10	6-15	1.15-1.40	0.60-2.00	0.13-0.22	Low-----	2.0-4.0	0.24	0.24	5	3	86
	10-17	15-27	1.20-1.40	0.60-2.00	0.13-0.22	Low-----	0.5-1.0	0.37	0.37			
	17-31	22-35	1.40-1.60	0.20-0.60	0.16-0.19	Moderate	0.0-0.5	0.37	0.37			
	31-60	18-30	1.40-1.60	0.20-0.60	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
428: Hassman-----	0-4	---	0.20-0.80	0.60-6.00	0.35-0.48	-----	25-99	---	---	5	2	134
	4-8	20-40	1.00-1.35	0.60-2.00	0.18-0.24	Moderate	5.0-20	0.28	0.28			
	8-45	35-60	1.40-1.55	0.06-0.20	0.10-0.19	High-----	0.0-0.5	0.32	0.32			
	45-60	30-60	1.35-1.55	0.06-0.20	0.09-0.19	High-----	0.0-0.5	0.32	0.32			
454B: Mahtomedi-----	0-3	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	3-6	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	6-28	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	28-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			
454C: Mahtomedi-----	0-4	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	4-17	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	17-38	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	38-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			
454E: Mahtomedi-----	0-1	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	1-14	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	14-25	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	25-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			
454F: Mahtomedi-----	0-2	2-10	1.40-1.50	6.00-20.00	0.06-0.10	Low-----	0.5-1.0	0.10	0.17	5	8	---
	2-15	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	15-30	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	30-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
458B: Menahga-----	0-14	2-10	1.20-1.50	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.15	0.15	5	2	134
	14-25	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.5-1.0	0.15	0.15			
	25-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.15	0.15			
458C: Menahga-----	0-4	2-10	1.20-1.50	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.15	0.15	5	2	134
	4-23	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.5-1.0	0.15	0.15			
	23-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.15	0.15			
458E: Menahga-----	0-10	2-10	1.20-1.50	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.15	0.15	5	2	134
	10-25	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.5-1.0	0.15	0.15			
	25-60	0-5	1.50-1.65	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.15	0.15			
464B: Brennyville----	0-5	8-16	1.35-1.55	0.60-2.00	0.22-0.24	Low-----	1.0-4.0	0.37	0.37	4	5	56
	5-18	5-12	1.40-1.60	0.60-2.00	0.17-0.22	Low-----	0.5-2.0	0.37	0.37			
	18-24	8-18	1.40-1.60	0.60-2.00	0.20-0.24	Low-----	0.0-0.5	0.37	0.37			
	24-32	10-18	1.55-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.24	0.28			
	32-38	5-16	1.65-1.75	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.24	0.28			
	38-60	5-16	1.80-2.00	0.00-0.20	0.00-0.04	Low-----	0.0-0.5	0.24	0.28			
469B: Hilicity-----	0-6	4-10	1.30-1.55	0.60-2.00	0.20-0.24	Low-----	0.5-3.0	0.37	0.37	5	5	56
	6-20	3-10	1.30-1.55	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.43	0.43			
	20-43	6-18	1.35-1.60	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.43	0.43			
	43-60	10-26	1.50-1.80	0.20-2.00	0.11-0.22	Low-----	0.0-0.5	0.24	0.28			
502: Dusler-----	0-5	10-20	1.35-1.45	0.60-2.00	0.20-0.24	Low-----	1.0-3.0	0.37	0.37	5	6	48
	5-21	5-20	1.40-1.50	0.60-2.00	0.16-0.22	Low-----	0.5-1.0	0.37	0.37			
	21-50	20-35	1.50-1.70	0.20-0.60	0.15-0.19	Low-----	0.5-1.0	0.37	0.37			
	50-60	18-30	1.55-1.75	0.06-0.20	0.10-0.15	Low-----	0.0-0.5	0.37	0.37			
504B: Duluth-----	0-11	5-15	1.35-1.45	0.60-2.00	0.16-0.22	Low-----	0.5-2.0	0.37	0.37	5	3	86
	11-41	25-35	1.60-1.75	0.06-0.60	0.15-0.19	Moderate	0.5-1.0	0.37	0.37			
	41-60	20-32	1.60-1.75	0.06-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
504C: Duluth-----	0-12	5-15	1.35-1.45	0.60-2.00	0.16-0.22	Low-----	0.5-2.0	0.37	0.37	5	3	86
	12-49	25-35	1.60-1.75	0.06-0.60	0.15-0.19	Moderate	0.5-1.0	0.37	0.37			
	49-60	20-32	1.60-1.75	0.06-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
504E: Duluth-----	0-14	5-15	1.35-1.45	0.60-2.00	0.16-0.22	Low-----	0.5-2.0	0.37	0.37	5	3	86
	14-37	25-35	1.60-1.75	0.06-0.60	0.15-0.19	Moderate	0.5-1.0	0.37	0.37			
	37-60	20-32	1.60-1.75	0.06-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
531: Beseman-----	0-14	---	0.10-0.25	0.60-6.00	0.55-0.65	-----	25-99	---	---	2	2	134
	14-40	---	0.10-0.25	0.60-6.00	0.55-0.65	-----	25-75	---	---			
	40-60	10-27	1.55-1.95	0.20-0.60	0.11-0.18	Moderate	0.0-0.5	0.28	0.37			
532: Sago-----	0-11	---	0.15-0.25	0.60-6.00	0.35-0.45	Low-----	50-95	---	---	5	2	134
	11-60	6-18	1.50-1.70	0.60-2.00	0.14-0.20	Low-----	0.0-2.0	0.28	0.28			
533: Loxley-----	0-3	---	0.30-0.40	6.00-20.00	0.35-0.65	-----	70-90	---	---	3	7	38
	3-60	---	0.10-0.35	0.20-6.00	0.35-0.45	-----	70-90	---	---			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
540: Seelyeville-----	0-9	---	0.10-0.25	0.20-6.00	0.35-0.45	-----	25-99	---	---	3	2	134
	9-60	---	0.10-0.25	0.20-6.00	0.35-0.45	-----	25-99	---	---			
541: Rifle-----	0-10	---	0.20-0.35	6.00-20.00	0.58-0.70	-----	75-99	---	---	5	7	38
	10-60	---	0.08-0.20	0.60-6.00	0.48-0.58	-----	25-99	---	---			
543: Markey-----	0-35	---	0.15-0.45	0.20-6.00	0.35-0.45	-----	55-85	---	---	4	2	134
	35-60	0-10	1.40-1.65	6.00-20.00	0.03-0.08	Low-----	0.0-0.5	0.15	0.15			
544: Cathro-----	0-20	---	0.28-0.45	0.20-6.00	0.45-0.55	-----	60-85	---	---	5	2	134
	20-38	---	0.15-0.30	0.20-6.00	0.35-0.45	-----	60-85	---	---			
	38-60	10-30	1.50-1.70	0.20-2.00	0.11-0.22	Low-----	1.0-5.0	0.20	0.24			
546: Lupton-----	0-13	---	0.10-0.35	0.20-6.00	0.35-0.45	-----	70-90	---	---	5	2	134
	13-60	---	0.10-0.35	0.20-6.00	0.35-0.45	-----	---	---	---			
549: Greenwood-----	0-14	---	0.30-0.40	6.00-20.00	0.55-0.65	-----	55-75	---	---	5	7	38
	14-60	---	0.10-0.25	0.60-6.00	0.45-0.55	-----	55-75	---	---			
563: Northwood-----	0-9	---	0.18-0.25	2.00-6.00	0.35-0.45	-----	50-85	---	---	5	2	134
	9-13	3-18	1.45-1.65	2.00-20.00	0.09-0.17	Low-----	0.5-2.0	0.15	0.15			
	13-35	1-10	1.55-1.70	6.00-20.00	0.06-0.11	Low-----	0.0-0.5	0.15	0.15			
	35-60	7-30	1.40-1.75	0.60-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
564: Friendship-----	0-3	3-8	1.50-1.65	6.00-20.00	0.08-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	3-6	2-7	1.35-1.65	6.00-60.00	0.05-0.11	Low-----	0.0-0.5	0.15	0.15			
	6-39	0-4	1.50-1.65	6.00-60.00	0.05-0.08	Low-----	0.0-0.5	0.15	0.15			
	39-60	0-4	1.50-1.70	6.00-60.00	0.04-0.07	Low-----	0.0-0.5	0.15	0.15			
607: Pengilly-----	0-4	12-18	1.25-1.40	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.32	0.32	5	5	56
	4-60	6-18	1.40-1.60	0.60-2.00	0.12-0.20	Low-----	0.0-1.0	0.24	0.24			
615: Cowhorn-----	0-7	2-10	1.20-1.40	2.00-6.00	0.16-0.20	Low-----	1.0-2.0	0.37	0.37	5	2	134
	7-39	2-10	1.40-1.60	2.00-6.00	0.12-0.19	Low-----	0.5-1.0	0.24	0.24			
	39-60	2-10	1.40-1.60	2.00-6.00	0.12-0.19	Low-----	0.0-0.5	0.24	0.24			
617B: Goodland-----	0-12	4-10	1.35-1.55	0.60-2.00	0.20-0.24	Low-----	0.5-2.0	0.37	0.37	5	5	56
	12-24	8-18	1.60-1.75	0.60-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28			
	24-33	2-10	1.65-1.85	2.00-6.00	0.06-0.10	Low-----	0.0-0.5	0.10	0.15			
	33-60	0-5	1.65-1.85	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.10	0.10			
618B: Itasca-----	0-11	3-10	1.35-1.55	0.60-2.00	0.22-0.24	Low-----	0.5-3.0	0.37	0.37	5	5	56
	11-21	3-10	1.60-1.75	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.37	0.37			
	21-28	8-18	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.5-1.0	0.24	0.24			
	28-60	8-15	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.24	0.24			
621: Morph-----	0-13	4-12	1.40-1.55	2.00-6.00	0.13-0.22	Low-----	1.0-4.0	0.24	0.24	5	3	86
	13-33	18-30	1.55-1.70	0.60-2.00	0.11-0.19	Low-----	0.5-1.0	0.24	0.24			
	33-60	8-27	1.55-1.70	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.24	0.24			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
625: Sandwick-----	0-6	0-8	1.45-1.55	6.00-20.00	0.08-0.10	Low-----	0.5-2.0	0.17	0.17	4	2	134
	6-34	0-8	1.50-1.60	6.00-20.00	0.06-0.09	Low-----	0.5-1.0	0.15	0.15			
	34-55	18-35	1.65-1.80	0.20-0.60	0.10-0.16	Moderate	0.5-1.0	0.32	0.37			
	55-60	18-30	1.65-1.80	0.20-0.60	0.02-0.10	Low-----	0.0-0.5	0.32	0.37			
627: Tawas-----	0-13	---	0.30-0.55	0.20-6.00	0.35-0.45	-----	40-60	---	---	2	2	134
	13-31	---	0.30-0.55	0.20-6.00	0.24-0.45	-----	40-60	---	---			
	31-60	0-10	1.40-1.65	6.00-20.00	0.03-0.10	Low-----	---	0.15	0.15			
628: Talmoon-----	0-4	---	0.13-0.42	2.00-6.00	0.25-0.40	-----	15-50	---	---	5	2	134
	4-20	15-27	1.20-1.40	0.60-2.00	0.13-0.22	Moderate	0.5-1.0	0.28	0.28			
	20-42	18-35	1.40-1.60	0.20-0.60	0.16-0.19	Moderate	0.0-0.5	0.37	0.37			
	42-60	15-35	1.40-1.60	0.20-0.60	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
629B: Wawina-----	0-23	2-10	1.40-1.55	2.00-6.00	0.16-0.18	Low-----	0.5-2.0	0.24	0.24	5	2	134
	23-60	2-10	1.55-1.70	2.00-6.00	0.14-0.16	Low-----	0.0-0.5	0.24	0.24			
672: Willossippi-----	0-7	8-26	1.20-1.40	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.32	0.32	5	5	56
	7-12	4-25	1.35-1.50	0.60-6.00	0.15-0.22	Low-----	0.5-1.0	0.28	0.28			
	12-42	10-30	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28			
	42-60	8-30	1.35-1.50	0.20-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28			
685: Oesterle-----	0-10	8-15	1.40-1.70	0.60-6.00	0.10-0.18	Low-----	2.0-3.0	0.24	0.24	4	3	86
	10-21	8-15	1.40-1.70	0.60-6.00	0.09-0.20	Low-----	0.5-1.0	0.24	0.24			
	21-34	7-17	1.40-1.70	0.60-6.00	0.05-0.18	Low-----	0.0-0.5	0.24	0.24			
	34-60	1-6	1.50-1.75	6.00-20.00	0.01-0.07	Low-----	0.0-0.5	0.10	0.15			
732B: Bushville-----	0-11	2-10	1.40-1.50	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.17	0.17	4	2	134
	11-26	2-8	1.50-1.70	6.00-20.00	0.06-0.09	Low-----	0.0-0.5	0.15	0.15			
	26-31	10-18	1.55-1.65	0.60-2.00	0.10-0.15	Low-----	0.0-0.5	0.24	0.28			
	31-50	5-16	1.65-1.75	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.24	0.28			
	50-60	5-16	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.24	0.28			
734: Cormant-----	0-8	3-10	1.30-1.50	6.00-20.00	0.08-0.12	Low-----	2.0-6.0	0.17	0.17	5	2	134
	8-60	4-14	1.40-1.65	0.60-20.00	0.11-0.16	Low-----	0.0-0.5	0.24	0.24			
736: Ronneby-----	0-5	5-18	1.35-1.65	2.00-6.00	0.13-0.18	Low-----	3.0-6.0	0.24	0.24	4	3	86
	5-28	5-18	1.40-1.65	0.60-6.00	0.12-0.19	Low-----	0.5-2.0	0.28	0.28			
	28-37	6-18	1.40-1.65	0.60-2.00	0.12-0.19	Low-----	0.5-1.0	0.28	0.28			
	37-46	4-18	1.65-1.80	0.06-0.20	0.03-0.08	Low-----	0.0-0.5	0.28	0.28			
	46-60	4-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
Mora-----	0-3	5-15	1.30-1.60	2.00-6.00	0.15-0.17	Low-----	0.5-3.0	0.28	0.28	4	3	86
	3-7	6-18	1.40-1.70	0.60-6.00	0.14-0.19	Low-----	0.0-0.5	0.28	0.28			
	7-25	8-18	1.50-1.65	0.60-2.00	0.15-0.19	Low-----	0.0-0.5	0.28	0.28			
	25-43	6-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	43-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			

Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
738B:												
Milaca-----	0-4	8-15	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-1.0	0.28	0.28	4	3	86
	4-17	8-15	1.40-1.60	2.00-6.00	0.18-0.22	Low-----	0.0-0.5	0.28	0.28			
	17-22	8-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28			
	22-33	8-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	33-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
Millward-----	0-4	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	2.0-4.0	0.24	0.28	4	3	86
	4-21	5-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.5-2.0	0.24	0.28			
	21-34	0-6	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.10	0.15			
	34-46	8-18	1.65-1.80	0.60-2.00	0.12-0.16	Low-----	0.5-1.0	0.20	0.28			
	46-60	5-15	1.65-1.80	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.20	0.28			
738C:												
Milaca-----	0-3	8-15	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	0.5-1.0	0.28	0.28	4	3	86
	3-14	8-15	1.40-1.60	2.00-6.00	0.18-0.22	Low-----	0.0-0.5	0.28	0.28			
	14-21	8-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.28	0.28			
	21-32	6-18	1.65-1.75	0.00-0.20	0.00-0.08	Low-----	0.0-0.5	0.28	0.28			
	32-60	6-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.20	0.28			
Millward-----	0-8	5-18	1.40-1.60	2.00-6.00	0.13-0.18	Low-----	2.0-4.0	0.24	0.28	4	3	86
	8-23	5-18	1.45-1.65	0.60-2.00	0.12-0.16	Low-----	0.5-2.0	0.24	0.28			
	23-34	0-6	1.35-1.60	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.10	0.15			
	34-43	8-18	1.65-1.80	0.60-2.00	0.12-0.16	Low-----	0.5-1.0	0.20	0.28			
	43-60	5-15	1.65-1.80	0.60-2.00	0.12-0.16	Low-----	0.0-0.5	0.20	0.28			
759:												
Waukenabo-----	0-6	4-18	1.15-1.30	2.00-6.00	0.13-0.18	Low-----	2.0-4.0	0.24	0.24	5	3	86
	6-15	2-14	1.20-1.40	2.00-6.00	0.10-0.14	Low-----	1.0-3.0	0.20	0.20			
	15-28	6-18	1.40-1.65	0.60-2.00	0.12-0.17	Low-----	0.5-1.0	0.28	0.28			
	28-30	4-14	1.40-1.65	0.60-6.00	0.12-0.17	Low-----	0.0-0.5	0.28	0.28			
	30-60	4-14	1.50-1.80	0.60-6.00	0.11-0.16	Low-----	0.0-0.5	0.37	0.37			
795:												
Redby-----	0-7	2-10	1.40-1.60	6.00-20.00	0.08-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	7-25	1-8	1.55-1.70	6.00-20.00	0.07-0.10	Low-----	0.0-0.5	0.17	0.17			
	25-42	0-6	1.55-1.70	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.17	0.17			
	42-60	2-15	1.55-1.70	6.00-20.00	0.08-0.12	Low-----	0.0-0.5	0.17	0.17			
797:												
Mooseiake-----	0-3	---	0.05-0.30	0.60-6.00	0.35-0.55	-----	25-99	---	---	3	5	56
	3-60	---	0.10-0.20	0.60-6.00	0.40-0.50	-----	25-99	---	---			
Lupton-----	0-8	---	0.20-0.35	0.60-6.00	0.45-0.55	-----	70-90	---	---	5	5	56
	8-60	---	0.10-0.35	0.20-6.00	0.35-0.45	-----	---	---	---			
798:												
Sago-----	0-13	---	0.15-0.25	0.60-6.00	0.35-0.45	Low-----	50-95	---	---	5	2	134
	13-60	6-18	1.50-1.70	0.60-2.00	0.14-0.20	Low-----	0.0-2.0	0.28	0.28			
Roscommon-----	0-6	0-12	0.90-1.60	6.00-20.00	0.08-0.20	Low-----	4.0-15	0.17	0.17	5	2	134
	6-60	0-10	1.45-1.70	6.00-20.00	0.05-0.09	Low-----	---	0.17	0.17			
799:												
Seelyeville-----	0-28	---	0.10-0.25	0.20-6.00	0.35-0.45	-----	25-99	---	---	3	2	134
	28-60	---	0.10-0.25	0.20-6.00	0.35-0.45	-----	25-99	---	---			
Bowstring-----	0-38	0-5	0.15-0.30	0.20-6.00	0.35-0.45	-----	40-90	---	---	3	8	---
	38-43	1-12	1.40-1.60	0.60-20.00	0.08-0.14	Low-----	2.0-10	---	---			
	43-60	0-5	0.15-0.30	0.20-6.00	0.35-0.45	-----	40-90	---	---			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
869:												
Lobo-----	0-44	---	0.05-0.10	6.00-20.00	0.55-0.65	-----	25-99	---	---	3	8	---
	44-60	---	0.05-0.20	0.60-6.00	0.45-0.55	-----	25-99	---	---			
Waskish-----	0-60	---	0.05-0.10	6.00-20.00	0.55-0.65	-----	90-99	---	---	3	8	---
870B:												
Itasca-----	0-12	3-10	1.35-1.55	0.60-2.00	0.22-0.24	Low-----	0.5-3.0	0.37	0.37	5	5	56
	12-16	3-10	1.60-1.75	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.37	0.37			
	16-37	8-18	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.5-1.0	0.24	0.24			
	37-60	8-15	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.24	0.24			
Goodland-----	0-13	4-10	1.35-1.55	0.60-2.00	0.20-0.24	Low-----	0.5-2.0	0.37	0.37	5	5	56
	13-30	8-18	1.60-1.75	0.60-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28			
	30-41	2-10	1.65-1.85	2.00-6.00	0.06-0.10	Low-----	0.0-0.5	0.10	0.15			
	41-60	0-5	1.65-1.85	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.10	0.10			
870C:												
Itasca-----	0-4	3-10	1.35-1.55	0.60-2.00	0.22-0.24	Low-----	0.5-3.0	0.37	0.37	5	5	56
	4-14	3-10	1.60-1.75	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.37	0.37			
	14-49	8-18	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.5-1.0	0.24	0.24			
	49-60	8-15	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.24	0.24			
Goodland-----	0-12	4-10	1.35-1.55	0.60-2.00	0.20-0.24	Low-----	0.5-2.0	0.37	0.37	5	5	56
	12-25	8-18	1.60-1.75	0.60-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28			
	25-33	2-10	1.65-1.85	2.00-6.00	0.06-0.10	Low-----	0.0-0.5	0.10	0.15			
	33-60	0-5	1.65-1.85	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.10	0.10			
870E:												
Itasca-----	0-2	3-10	1.35-1.55	0.60-2.00	0.22-0.24	Low-----	0.5-3.0	0.37	0.37	5	5	56
	2-14	3-10	1.60-1.75	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.37	0.37			
	14-53	8-18	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.5-1.0	0.24	0.24			
	53-60	8-15	1.60-1.80	0.60-2.00	0.11-0.19	Low-----	0.0-0.5	0.24	0.24			
Goodland-----	0-8	4-10	1.35-1.55	0.60-2.00	0.20-0.24	Low-----	0.5-2.0	0.37	0.37	5	5	56
	8-23	8-18	1.60-1.75	0.60-2.00	0.12-0.19	Low-----	0.0-0.5	0.28	0.28			
	23-34	2-10	1.65-1.85	2.00-6.00	0.06-0.10	Low-----	0.0-0.5	0.10	0.15			
	34-60	0-5	1.65-1.85	6.00-20.00	0.02-0.07	Low-----	0.0-0.5	0.10	0.10			
872:												
Pengilly-----	0-4	12-18	1.25-1.40	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.32	0.32	5	5	56
	4-60	6-18	1.40-1.60	0.60-2.00	0.12-0.20	Low-----	0.0-1.0	0.24	0.24			
Winterfield----	0-6	0-15	0.90-1.50	2.00-20.00	0.10-0.12	Low-----	2.0-4.0	0.17	0.17	5	2	134
	6-41	0-15	1.45-1.60	6.00-20.00	0.06-0.11	Low-----	0.0-0.5	0.17	0.17			
	41-60	0-10	1.55-1.65	6.00-20.00	0.04-0.10	Low-----	0.0-0.5	0.10	0.17			
928C:												
Cushing-----	0-16	6-14	1.35-1.65	0.60-2.00	0.10-0.22	Low-----	1.0-2.0	0.24	0.24	5	3	86
	16-19	4-16	1.55-1.65	0.60-2.00	0.10-0.22	Low-----	0.1-1.0	0.32	0.32			
	19-44	18-35	1.55-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.32	0.32			
	44-60	8-21	1.45-1.80	0.20-0.60	0.09-0.19	Low-----	0.0-0.5	0.32	0.32			
Mahtomedi-----	0-4	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	4-15	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	15-26	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	26-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			

Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
928D:												
Cushing-----	0-7	6-18	1.35-1.65	0.60-2.00	0.16-0.24	Low-----	1.0-3.0	0.32	0.32	5	5	56
	7-17	4-16	1.55-1.65	0.60-2.00	0.10-0.22	Low-----	0.1-1.0	0.32	0.32			
	17-30	18-35	1.55-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.32	0.32			
	30-60	8-21	1.45-1.80	0.20-0.60	0.09-0.19	Low-----	0.0-0.5	0.32	0.32			
Mahtomedi-----	0-3	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	3-13	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	13-25	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	25-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			
928F:												
Cushing-----	0-4	6-14	1.35-1.65	0.60-2.00	0.10-0.22	Low-----	1.0-2.0	0.24	0.24	5	3	86
	4-14	4-16	1.55-1.65	0.60-2.00	0.10-0.22	Low-----	0.1-1.0	0.32	0.32			
	14-35	18-35	1.55-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.32	0.32			
	35-60	8-21	1.45-1.80	0.20-0.60	0.09-0.19	Low-----	0.0-0.5	0.32	0.32			
Mahtomedi-----	0-4	2-15	1.40-1.60	6.00-20.00	0.10-0.12	Low-----	0.5-1.0	0.15	0.15	5	2	134
	4-20	0-10	1.40-1.50	6.00-20.00	0.06-0.08	Low-----	0.0-0.5	0.10	0.10			
	20-35	0-10	1.45-1.75	6.00-20.00	0.05-0.07	Low-----	0.0-0.5	0.05	0.10			
	35-60	0-10	1.45-1.75	6.00-20.00	0.04-0.09	Low-----	0.0-0.5	0.05	0.10			
980:												
Blackhoof-----	0-10	---	0.15-0.30	0.60-6.00	0.55-0.65	-----	25-50	---	---	3	2	134
	10-14	22-35	1.60-1.75	0.06-0.20	0.16-0.20	Moderate	1.0-4.0	0.28	0.28			
	14-60	22-35	1.60-1.75	0.06-0.20	0.14-0.17	Moderate	0.0-0.5	0.32	0.32			
Mahtowa-----	0-3	---	0.15-0.30	0.60-6.00	0.55-0.65	Low-----	25-50	---	---	5	2	134
	3-11	18-35	1.55-1.75	0.20-0.60	0.17-0.19	Low-----	0.5-1.0	0.37	0.37			
	11-60	18-35	1.55-1.75	0.60-6.00	0.14-0.19	Low-----	0.0-0.5	0.37	0.37			
990:												
Twig-----	0-10	---	0.25-0.35	0.60-6.00	0.35-0.55	-----	25-50	---	---	4	2	134
	10-16	8-18	1.65-1.85	0.06-0.60	0.20-0.22	Low-----	1.0-5.0	0.37	0.37			
	16-44	8-18	1.80-2.00	0.00-0.06	0.07-0.10	Low-----	0.5-1.0	0.37	0.37			
	44-52	8-18	1.60-1.70	0.20-0.60	0.11-0.16	Low-----	0.0-0.5	0.28	0.28			
	52-60	8-18	1.80-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.28	0.28			
Giese-----	0-4	---	0.25-0.35	0.20-6.00	0.35-0.55	-----	25-50	---	---	4	2	134
	4-10	8-27	1.30-1.50	0.60-6.00	0.13-0.22	Low-----	4.0-7.0	0.28	0.32			
	10-21	4-18	1.50-1.65	2.00-6.00	0.09-0.15	Low-----	0.5-2.0	0.20	0.24			
	21-43	6-20	1.75-1.90	0.60-2.00	0.15-0.18	Low-----	0.5-1.0	0.20	0.24			
	43-70	6-18	1.80-1.95	0.06-0.20	0.00-0.04	Low-----	0.0-0.5	0.17	0.24			
	70-80	6-18	1.85-2.00	0.00-0.06	0.00-0.04	Low-----	0.0-0.5	0.17	0.24			
1002:												
Borosaprists----	0-27	---	0.10-0.25	0.20-6.00	0.35-0.45	Low-----	25-99	---	---	3	2	134
	27-48	---	0.10-0.25	0.20-6.00	0.35-0.45	Low-----	25-99	---	---			
	48-60	2-27	1.25-1.65	0.20-6.00	0.12-0.22	Moderate	0.0-0.5	---	---			
Fluvaquents-----	0-16	6-18	1.20-1.40	0.60-2.00	0.18-0.24	Low-----	3.0-10	0.28	0.28	5	5	56
	16-60	10-27	1.30-1.60	0.60-2.00	0.12-0.22	Moderate	0.5-2.0	0.24	0.24			
1030:												
Pits.												
Udipsamments----	0-14	1-15	1.50-1.70	2.00-20.00	0.05-0.10	Low-----	---	0.15	0.15	5	2	---
	14-60	1-10	1.50-1.70	6.00-20.00	0.05-0.08	Low-----	---	0.10	0.10			
	60-80	1-10	1.50-1.70	>20.00	0.03-0.05	Low-----	---	0.05	0.10			

## Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
1031: Histosols-----	0-40	---	0.15-0.45	2.00-6.00	0.35-0.45	Low-----	20-99	---	---	3	8	---
	40-60	0-5	1.60-1.80	6.00-20.00	0.06-0.07	Low-----	0.0-0.5	0.15	0.15			
1072: Udorthents.												
1115: Newson-----	0-6	4-12	1.35-1.65	2.00-6.00	0.08-0.13	Low-----	4.0-10	0.17	0.17	5	2	134
	6-23	1-4	1.70-1.80	6.00-20.00	0.05-0.11	Low-----	0.1-2.0	0.17	0.17			
	23-60	1-4	1.70-1.80	6.00-20.00	0.04-0.11	Low-----	0.0-0.5	0.15	0.15			
1150: Jevne-----	0-6	6-15	1.15-1.40	2.00-6.00	0.13-0.22	Low-----	4.0-8.0	0.20	0.24	5	3	86
	6-19	6-20	1.20-1.40	0.60-2.00	0.13-0.22	Low-----	0.5-2.0	0.32	0.37			
	19-43	18-35	1.40-1.60	0.60-2.00	0.16-0.19	Moderate	0.5-1.0	0.32	0.37			
	43-60	10-30	1.40-1.60	0.20-20.00	0.12-0.19	Moderate	0.0-0.5	0.32	0.37			
1154: Sax-----	0-12	0-1	0.33-0.55	0.20-6.00	0.35-0.45	-----	25-70	---	---	5	2	134
	12-15	18-35	1.30-1.50	0.60-2.00	0.17-0.22	Low-----	3.0-15	0.28	0.28			
	15-39	18-35	1.30-1.50	0.60-2.00	0.17-0.22	Low-----	0.5-1.0	0.43	0.43			
	39-60	10-35	1.30-1.55	0.60-2.00	0.14-0.22	Low-----	0.0-0.5	0.43	0.43			
1353B: Cutaway-----	0-11	0-8	1.45-1.55	6.00-20.00	0.10-0.12	Low-----	0.5-2.0	0.17	0.17	5	2	134
	11-26	0-8	1.50-1.60	6.00-20.00	0.06-0.11	Low-----	0.5-1.0	0.17	0.17			
	26-49	18-35	1.60-1.75	0.20-2.00	0.12-0.19	Moderate	0.5-1.0	0.37	0.37			
	49-60	18-30	1.60-1.75	0.20-2.00	0.12-0.19	Low-----	0.0-0.5	0.37	0.37			
1354A: Aftad-----	0-3	3-8	1.35-1.65	0.60-2.00	0.14-0.18	Low-----	1.0-3.0	0.24	0.24	5	3	86
	3-25	3-12	1.45-1.70	0.60-2.00	0.09-0.19	Low-----	0.5-1.0	0.43	0.43			
	25-44	8-15	1.50-1.70	0.60-2.00	0.10-0.19	Low-----	0.0-0.5	0.43	0.43			
	44-60	1-12	1.50-1.75	0.60-2.00	0.05-0.20	Low-----	0.0-0.5	0.32	0.32			
1372: Wealthwood-----	0-4	0-15	1.30-1.40	6.00-20.00	0.10-0.12	Low-----	2.0-4.0	0.17	0.17	5	2	134
	4-28	0-15	1.40-1.60	6.00-20.00	0.06-0.10	Low-----	0.5-1.0	0.15	0.15			
	28-42	12-27	1.40-1.70	0.20-6.00	0.15-0.19	Moderate	0.0-0.5	0.32	0.32			
	42-60	7-18	1.40-1.70	0.60-6.00	0.12-0.16	Low-----	0.0-0.5	0.24	0.24			
1375B: Alban-----	0-5	3-8	1.35-1.65	0.60-2.00	0.13-0.18	Low-----	0.5-2.0	0.24	0.24	5	3	86
	5-23	3-15	1.60-1.70	0.60-2.00	0.09-0.22	Low-----	0.2-0.6	0.17	0.17			
	23-29	8-18	1.55-1.65	0.60-2.00	0.12-0.20	Low-----	0.0-0.5	0.24	0.24			
	29-60	1-12	1.50-1.70	0.60-2.00	0.05-0.22	Low-----	0.0-0.5	0.24	0.24			
1878: Hanre-----	0-10	---	0.18-0.22	0.20-2.00	0.35-0.48	Low-----	85-95	---	---	5	2	134
	10-17	18-35	1.30-1.70	0.20-2.00	0.17-0.19	Moderate	4.0-10	0.32	0.32			
	17-60	18-35	1.40-1.70	0.20-2.00	0.17-0.19	Moderate	0.5-2.0	0.32	0.32			
1982: Baudette-----	0-4	10-27	1.20-1.40	0.60-2.00	0.20-0.22	Low-----	1.0-4.0	0.37	0.37	5	6	48
	4-9	5-27	1.30-1.50	0.60-2.00	0.14-0.20	Low-----	0.5-1.0	0.37	0.37			
	9-21	18-35	1.25-1.45	0.60-2.00	0.17-0.24	Moderate	0.5-1.0	0.37	0.37			
	21-60	5-27	1.30-1.60	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37			
Spooner-----	0-7	10-24	1.25-1.40	0.60-2.00	0.20-0.24	Low-----	2.0-4.0	0.37	0.37	5	5	56
	7-22	3-18	1.35-1.55	0.60-6.00	0.17-0.19	Low-----	0.5-1.0	0.37	0.37			
	22-27	18-35	1.30-1.50	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37			
	27-60	5-32	1.40-1.60	0.60-2.00	0.17-0.22	Low-----	0.0-0.5	0.37	0.37			

Physical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
1983: Cathro-----	0-16	---	0.28-0.45	0.20-6.00	0.45-0.55	-----	50-95	---	---	2	2	134
	16-35	---	0.18-0.35	0.20-6.00	0.35-0.45	-----	50-95	---	---			
	35-60	6-30	1.40-1.70	0.60-20.00	0.10-0.20	Low-----	---	0.24	0.24			
1984: Leafriver-----	0-13	---	0.10-0.25	0.60-6.00	0.35-0.50	-----	50-90	---	---	5	2	134
	13-17	3-18	1.40-1.65	2.00-20.00	0.08-0.14	Low-----	5.0-20	0.17	0.17			
	17-60	0-10	1.50-1.65	6.00-20.00	0.03-0.08	Low-----	0.5-5.0	0.17	0.17			

## Chemical Properties of the Soils

(Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
72:					
Shooker-----	0-9	5-20	6.0-20.0	5.6-7.3	---
	9-27	18-35	18.0-23.0	5.6-7.8	---
	27-60	12-27	5.0-17.0	7.4-8.4	5-30
119C:					
Pomroy-----	0-4	5-12	3.0-9.0	5.1-6.5	---
	4-15	2-10	1.0-7.0	5.1-6.5	---
	15-22	6-18	3.0-12.0	5.1-6.5	---
	22-44	5-15	2.0-10.0	5.6-7.3	---
	44-60	5-15	2.0-10.0	5.6-7.3	---
124:					
Brickton-----	0-11	15-27	13.0-30.0	5.6-7.3	---
	11-32	35-60	22.0-50.0	5.1-7.8	0-5
	32-60	28-60	18.0-50.0	7.4-8.4	15-35
133B:					
Dalbo-----	0-13	5-20	4.0-20.0	5.6-7.3	---
	13-35	35-60	14.0-40.0	5.1-7.3	---
	35-60	35-60	10.0-40.0	7.4-8.4	5-30
142:					
Nokay-----	0-6	4-12	7.0-19.0	4.5-5.5	---
	6-12	5-15	4.0-13.0	4.5-5.5	---
	12-19	8-18	3.0-11.0	5.1-6.5	---
	19-44	4-18	1.0-11.0	5.6-7.3	---
	44-60	4-18	1.0-11.0	5.6-7.3	---
144B:					
Flak-----	0-3	5-18	3.0-15.0	4.5-6.5	---
	3-13	5-18	2.0-11.0	5.1-6.5	---
	13-22	8-18	3.0-11.0	5.1-6.5	---
	22-45	4-18	1.0-11.0	5.1-7.3	---
	45-60	4-18	1.0-11.0	5.6-7.3	---
144C:					
Flak-----	0-2	5-18	3.0-15.0	4.5-6.5	---
	2-5	5-18	2.0-11.0	5.1-6.5	---
	5-16	8-18	3.0-11.0	5.1-6.5	---
	16-34	4-18	1.0-11.0	5.1-7.3	---
	34-60	4-18	1.0-11.0	5.6-7.3	---
146B:					
Wabedo-----	0-5	8-18	4.0-19.0	4.5-6.0	---
	5-27	5-18	3.0-13.0	4.5-6.5	---
	27-47	4-18	2.0-12.0	5.1-7.3	---
	47-60	4-18	2.0-12.0	5.1-7.3	---
147:					
Spooner-----	0-4	10-24	6.0-22.0	5.6-7.8	0-15
	4-10	3-18	1.0-11.0	5.6-7.8	0-15
	10-29	18-35	11.0-21.0	6.1-7.8	0-15
	29-60	5-32	2.0-20.0	7.4-8.4	10-40

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth		Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct		meq/100g	pH	Pct
152B:						
Milaca-----	0-3	8-15		4.0-12.0	5.1-6.5	---
	3-22	8-15		3.0-10.0	5.1-6.5	---
	22-32	8-18		3.0-12.0	5.1-6.5	---
	32-48	8-18		2.0-11.0	5.6-7.3	---
	48-60	6-18		2.0-11.0	5.6-7.3	---
152C:						
Milaca-----	0-3	8-15		4.0-12.0	5.1-6.5	---
	3-15	8-15		3.0-10.0	5.1-6.5	---
	15-20	8-18		3.0-12.0	5.1-6.5	---
	20-45	6-18		2.0-11.0	5.6-7.3	---
	45-60	6-18		2.0-11.0	5.6-7.3	---
152E:						
Milaca-----	0-4	8-15		4.0-12.0	5.1-6.5	---
	4-10	8-15		3.0-10.0	5.1-6.5	---
	10-22	8-18		3.0-12.0	5.1-6.5	---
	22-42	6-18		2.0-11.0	5.6-7.3	---
	42-60	6-18		2.0-11.0	5.6-7.3	---
164B:						
Mora-----	0-3	5-15		2.0-15.0	5.1-6.5	---
	3-15	6-18		2.0-11.0	5.1-6.5	---
	15-28	8-18		3.0-11.0	5.6-6.5	---
	28-42	6-18		2.0-11.0	5.6-7.3	---
	42-60	6-18		2.0-11.0	5.6-7.3	0-15
166:						
Ronneby-----	0-4	5-18		8.0-27.0	5.1-6.5	---
	4-22	5-18		2.0-15.0	5.1-6.5	---
	22-35	6-18		2.0-13.0	5.6-6.5	---
	35-45	4-18		2.0-11.0	5.6-7.3	---
	45-60	4-18		2.0-11.0	5.6-7.3	---
167B:						
Baudette-----	0-4	10-27		8.0-30.0	5.6-7.3	---
	4-13	5-27		4.0-24.0	5.6-7.3	---
	13-35	18-35		12.0-30.0	5.6-7.8	0-5
	35-60	5-27		3.0-23.0	7.4-8.4	10-20
186:						
Nemadji-----	0-11	2-10		2.0-12.0	4.5-5.5	---
	11-34	1-10		2.0-10.0	4.5-6.0	---
	34-60	0-5		0.0-6.0	4.5-6.0	---
188B:						
Omega-----	0-11	1-10		2.0-10.0	4.5-5.5	---
	11-60	0-5		0.0-4.0	5.1-7.3	---
188C:						
Omega-----	0-16	1-10		2.0-10.0	4.5-5.5	---
	16-60	0-5		0.0-4.0	5.1-7.3	---
188E:						
Omega-----	0-5	1-10		2.0-10.0	4.5-5.5	---
	5-60	0-5		0.0-4.0	5.1-7.3	---
202:						
Meehan-----	0-7	4-10		2.0-15.0	3.5-7.3	---
	7-28	4-9		1.0-8.0	3.5-6.5	---
	28-60	1-4		0.0-4.0	3.5-7.3	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
204B: Branstad-----	0-2	6-18	3.0-20.0	5.1-7.8	---
	2-17	4-16	1.0-15.0	5.1-7.8	---
	17-36	13-25	2.0-20.0	5.1-7.8	---
	36-43	18-27	4.0-25.0	5.1-6.5	---
	43-60	13-17	2.0-15.0	6.6-8.4	1-10
204C: Cushing-----	0-12	6-18	6.0-20.0	5.1-7.8	---
	12-25	4-16	3.0-15.0	5.1-7.8	---
	25-44	18-35	11.0-29.0	5.1-7.8	---
	44-60	8-21	5.0-18.0	5.1-8.4	0-10
204E: Cushing-----	0-5	6-18	6.0-20.0	5.1-7.8	---
	5-15	4-16	3.0-15.0	5.1-7.8	---
	15-29	18-35	11.0-29.0	5.1-7.8	---
	29-60	8-21	5.0-18.0	5.1-8.4	0-10
218: Watab-----	0-7	1-8	2.0-8.0	5.1-6.0	---
	7-28	1-10	0.0-6.0	5.1-6.5	---
	28-36	5-16	5.0-10.0	5.1-6.5	---
	36-54	6-16	2.0-11.0	5.6-7.3	---
	54-60	6-16	2.0-11.0	5.6-7.3	---
240B: Warba-----	0-14	5-15	4.0-15.0	5.1-6.5	---
	14-46	23-35	10.0-23.0	5.1-7.3	---
	46-60	20-32	8.0-20.0	6.6-8.4	5-15
240C: Warba-----	0-11	5-15	4.0-15.0	5.1-6.5	---
	11-42	23-35	10.0-23.0	5.1-7.3	---
	42-60	20-32	8.0-20.0	6.6-8.4	5-15
243: Stuntz-----	0-7	5-15	4.0-15.0	4.5-6.5	---
	7-37	20-35	9.0-23.0	5.1-7.8	---
	37-60	20-32	8.0-20.0	6.6-8.4	5-15
266: Freer-----	0-6	10-20	4.0-16.0	4.5-6.0	---
	6-21	10-18	4.0-11.0	4.5-6.0	---
	21-27	18-28	7.0-17.0	5.1-6.0	---
	27-35	18-28	7.0-17.0	5.1-6.0	---
	35-47	6-18	2.0-11.0	5.6-7.3	---
	47-60	6-18	2.0-11.0	5.6-7.3	---
268B: Cromwell-----	0-23	5-18	4.0-13.0	4.5-6.0	---
	23-60	0-8	0.0-5.0	5.1-7.3	---
268C: Cromwell-----	0-20	5-18	4.0-13.0	4.5-6.0	---
	20-60	0-8	0.0-5.0	5.1-7.3	---
268E: Cromwell-----	0-15	5-18	4.0-13.0	4.5-6.0	---
	15-60	0-8	0.0-5.0	5.1-7.3	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In Pct	Pct	meq/100g	pH	Pct
268F:					
Cromwell-----	0-18	5-18	4.0-13.0	4.5-6.0	---
	18-60	0-8	0.0-5.0	5.1-7.3	---
292:					
Alstad-----	0-4	6-18	5.0-25.0	4.5-7.8	---
	4-14	4-16	1.0-15.0	4.5-7.8	---
	14-22	13-25	2.0-20.0	4.5-7.8	---
	22-52	18-27	4.0-25.0	4.5-7.8	---
	52-60	13-17	2.0-15.0	7.4-8.4	1-10
302B:					
Rosholt-----	0-9	4-10	3.0-15.0	4.5-7.3	---
	9-15	3-12	1.0-10.0	4.5-6.5	---
	15-22	6-15	1.0-15.0	4.5-6.5	---
	22-30	4-12	1.0-10.0	4.5-6.5	---
	30-60	0-5	0.0-5.0	5.1-6.5	---
302C:					
Rosholt-----	0-2	4-10	3.0-15.0	4.5-7.3	---
	2-14	3-12	1.0-10.0	4.5-6.5	---
	14-26	6-15	1.0-15.0	4.5-6.5	---
	26-31	4-12	1.0-10.0	4.5-6.5	---
	31-60	0-5	0.0-5.0	5.1-6.5	---
346:					
Talmoon-----	0-10	6-15	6.0-14.0	5.1-7.3	---
	10-17	15-27	7.0-18.0	5.1-7.3	---
	17-31	22-35	8.0-20.0	5.6-7.3	---
	31-60	18-30	7.0-18.0	7.4-8.4	5-30
428:					
Hassman-----	0-4	---	52-198	---	---
	4-8	20-40	18.0-36.0	5.1-6.5	---
	8-45	35-60	22.0-50.0	5.1-7.3	---
	45-60	30-60	15.0-25.0	7.4-8.4	15-25
454B:					
Mahtomedi-----	0-3	2-15	2.0-11.0	5.1-6.5	---
	3-6	0-10	0.0-6.0	5.1-6.5	---
	6-28	0-10	0.0-6.0	5.1-6.5	---
	28-60	0-10	0.0-6.0	5.1-7.8	0-15
454C:					
Mahtomedi-----	0-4	2-15	2.0-11.0	5.1-6.5	---
	4-17	0-10	0.0-6.0	5.1-6.5	---
	17-38	0-10	0.0-6.0	5.1-6.5	---
	38-60	0-10	0.0-6.0	5.1-7.8	0-15
454E:					
Mahtomedi-----	0-1	2-15	2.0-11.0	5.1-6.5	---
	1-14	0-10	0.0-6.0	5.1-6.5	---
	14-25	0-10	0.0-6.0	5.1-6.5	---
	25-60	0-10	0.0-6.0	5.1-7.8	0-15
454F:					
Mahtomedi-----	0-2	2-10	2.0-8.0	5.1-6.5	---
	2-15	0-10	0.0-6.0	5.1-6.5	---
	15-30	0-10	0.0-6.0	5.1-6.5	---
	30-60	0-10	0.0-6.0	5.1-7.8	0-15

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth		Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct		meq/100g	pH	Pct
458B: Menahga-----	0-14	2-10		2.0-10.0	4.5-6.5	---
	14-25	0-5		1.0-4.0	4.5-6.5	---
	25-60	0-5		1.0-4.0	5.6-7.8	---
458C: Menahga-----	0-4	2-10		2.0-10.0	4.5-6.5	---
	4-23	0-5		1.0-4.0	4.5-6.5	---
	23-60	0-5		1.0-4.0	5.6-7.8	---
458E: Menahga-----	0-10	2-10		2.0-10.0	4.5-6.5	---
	10-25	0-5		1.0-4.0	4.5-6.5	---
	25-60	0-5		1.0-4.0	5.6-7.8	---
464B: Brennyville----	0-5	8-16		5.0-18.0	4.5-6.0	---
	5-18	5-12		3.0-11.0	4.5-6.5	---
	18-24	8-18		3.0-11.0	5.1-6.5	---
	24-32	10-18		4.0-11.0	5.1-7.3	---
	32-38	5-16		2.0-10.0	5.1-7.3	---
	38-60	5-16		2.0-10.0	5.1-7.8	0-5
469B: Hilicity-----	0-6	4-10		3.0-9.0	5.1-6.5	---
	6-20	3-10		1.0-6.0	5.1-6.5	---
	20-43	6-18		3.0-9.0	5.6-7.3	---
	43-60	10-26		5.0-13.0	6.6-8.4	5-15
502: Dusler-----	0-5	10-20		6.0-18.0	4.5-6.0	---
	5-21	5-20		6.0-14.0	4.5-6.0	---
	21-50	20-35		13.0-23.0	5.1-7.3	---
	50-60	18-30		7.0-19.0	6.6-7.8	0-5
504B: Duluth-----	0-11	5-15		10.0-30.0	4.5-6.0	---
	11-41	25-35		10.0-20.0	4.5-6.5	---
	41-60	20-32		10.0-20.0	6.1-7.8	0-5
504C: Duluth-----	0-12	5-15		10.0-30.0	4.5-6.0	---
	12-49	25-35		10.0-20.0	4.5-6.5	---
	49-60	20-32		10.0-20.0	6.1-7.8	0-5
504E: Duluth-----	0-14	5-15		10.0-30.0	4.5-6.0	---
	14-37	25-35		10.0-20.0	4.5-6.5	---
	37-60	20-32		10.0-20.0	6.1-7.8	0-5
531: Beseman-----	0-14	---		50-198	3.5-4.4	---
	14-40	---		50-150	3.5-4.4	---
	40-60	10-27		4.0-17.0	3.5-7.3	---
532: Sago-----	0-11	---		100-190	4.5-6.5	---
	11-60	6-18		4.0-18.0	5.6-8.4	0-20
533: Loxley-----	0-3	---		50-100	2.0-4.4	---
	3-60	---		50-120	2.0-4.4	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth		Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct		meq/100g	pH	Pct
540: Seelyeville-----	0-9	---	---	140-200	4.5-7.3	---
	9-60	---	---	140-200	4.5-7.3	---
541: Rifle-----	0-10	---	---	150-180	4.5-7.3	---
	10-60	---	---	50-150	4.5-7.3	---
543: Markey-----	0-35	---	---	110-170	4.5-7.8	0-5
	35-60	0-10	---	1.0-3.0	5.6-8.4	0-5
544: Cathro-----	0-20	---	---	120-170	4.5-7.8	---
	20-38	---	---	120-170	4.5-7.8	---
	38-60	10-30	---	2.0-25.0	6.6-8.4	5-25
546: Lupton-----	0-13	---	---	100-200	4.5-7.8	---
	13-60	---	---	100-200	4.5-7.8	---
549: Greenwood-----	0-14	---	---	100-200	3.6-4.4	---
	14-60	---	---	100-200	3.6-4.4	---
563: Northwood-----	0-9	---	---	100-170	5.1-7.8	---
	9-13	3-18	---	2.0-20.0	5.6-7.8	---
	13-35	1-10	---	2.0-7.0	5.6-8.4	0-5
	35-60	7-30	---	4.0-18.0	7.4-8.4	5-15
564: Friendship-----	0-3	3-8	---	2.0-10.0	3.5-7.3	---
	3-6	2-7	---	0.0-7.0	3.5-6.5	---
	6-39	0-4	---	0.0-4.0	4.5-7.3	---
	39-60	0-4	---	0.0-4.0	5.1-7.8	---
607: Pengilly-----	0-4	12-18	---	9.0-19.0	5.6-7.3	---
	4-60	6-18	---	2.0-13.0	6.1-8.4	0-15
615: Cowhorn-----	0-7	2-10	---	3.0-10.0	5.1-6.5	---
	7-39	2-10	---	2.0-8.0	5.1-6.5	---
	39-60	2-10	---	1.0-6.0	6.1-8.4	0-15
617B: Goodland-----	0-12	4-10	---	3.0-9.0	5.1-6.5	---
	12-24	8-18	---	4.0-9.0	5.1-6.5	---
	24-33	2-10	---	1.0-5.0	5.1-6.5	---
	33-60	0-5	---	0.0-2.0	5.6-7.8	---
618B: Itasca-----	0-11	3-10	---	2.0-12.0	5.1-6.5	---
	11-21	3-10	---	2.0-8.0	5.1-6.0	---
	21-28	8-18	---	4.0-13.0	5.6-7.3	---
	28-60	8-15	---	3.0-10.0	6.6-8.4	0-10
621: Morph-----	0-13	4-12	---	4.0-14.0	5.1-6.5	---
	13-33	18-30	---	10.0-16.0	5.1-7.3	---
	33-60	8-27	---	4.0-15.0	6.6-8.4	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
625:					
Sandwick-----	0-6	0-8	1.0-9.0	5.1-6.5	---
	6-34	0-8	1.0-8.0	5.1-6.5	---
	34-55	18-35	8.0-23.0	5.6-7.3	---
	55-60	18-30	7.0-19.0	6.6-8.4	0-20
627:					
Tawas-----	0-13	---	80-120	4.5-7.8	---
	13-31	---	80-120	4.5-7.8	---
	31-60	0-10	1.0-3.0	5.6-8.4	---
628:					
Talmoon-----	0-4	---	30-100	5.1-7.3	---
	4-20	15-27	7.0-18.0	5.1-7.3	---
	20-42	18-35	8.0-20.0	5.6-7.3	---
	42-60	15-35	7.0-18.0	7.4-8.4	5-30
629B:					
Wawina-----	0-23	2-10	3.0-10.0	5.1-6.5	---
	23-60	2-10	1.0-7.0	5.1-7.3	---
672:					
Willossippi-----	0-7	8-26	9.0-29.0	5.1-7.3	---
	7-12	4-25	7.0-29.0	5.1-7.3	---
	12-42	10-30	12.0-31.0	5.6-7.8	0-5
	42-60	8-30	6.0-25.0	6.6-8.4	5-15
685:					
Oesterle-----	0-10	8-15	6.0-20.0	4.5-6.5	---
	10-21	8-15	3.0-15.0	4.5-6.5	---
	21-34	7-17	1.0-10.0	4.5-6.5	---
	34-60	1-6	1.0-6.0	5.1-6.5	---
732B:					
Bushville-----	0-11	2-10	1.0-7.0	5.1-6.5	---
	11-26	2-8	1.0-4.0	5.1-6.5	---
	26-31	10-18	4.0-11.0	5.1-6.5	---
	31-50	5-16	3.0-10.0	5.1-7.3	---
	50-60	5-16	3.0-10.0	5.6-7.3	---
734:					
Cormant-----	0-8	3-10	6.0-17.0	6.1-7.3	---
	8-60	4-14	2.0-8.0	6.6-7.8	---
736:					
Ronneby-----	0-5	5-18	8.0-23.0	5.1-6.5	---
	5-28	5-18	2.0-15.0	5.1-6.5	---
	28-37	6-18	2.0-13.0	5.6-6.5	---
	37-46	4-18	2.0-11.0	5.6-7.3	---
	46-60	4-18	2.0-11.0	5.6-7.3	---
Mora-----	0-3	5-15	2.0-15.0	5.1-6.5	---
	3-7	6-18	2.0-11.0	5.1-6.5	---
	7-25	8-18	3.0-11.0	5.6-6.5	---
	25-43	6-18	2.0-11.0	5.6-7.3	---
	43-60	6-18	2.0-11.0	5.6-7.3	0-15
738B:					
Milaca-----	0-4	8-15	4.0-12.0	5.1-6.5	---
	4-17	8-15	3.0-10.0	5.1-6.5	---
	17-22	8-18	3.0-12.0	5.1-6.5	---
	22-33	8-18	2.0-11.0	5.6-7.3	---
	33-60	6-18	2.0-11.0	5.6-7.3	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth		Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct		meq/100g	pH	Pct
738B:						
Millward-----	0-4	5-18		6.0-15.0	4.5-6.5	---
	4-21	5-18		3.0-13.0	5.1-6.5	---
	21-34	0-6		0.0-5.0	5.1-6.5	---
	34-46	8-18		4.0-13.0	5.6-7.3	---
	46-60	5-15		2.0-12.0	5.6-7.3	---
738C:						
Milaca-----	0-3	8-15		4.0-12.0	5.1-6.5	---
	3-14	8-15		3.0-10.0	5.1-6.5	---
	14-21	8-18		3.0-12.0	5.1-6.5	---
	21-32	6-18		2.0-11.0	5.6-7.3	---
	32-60	6-18		2.0-11.0	5.6-7.3	---
Millward-----	0-8	5-18		6.0-15.0	4.5-6.5	---
	8-23	5-18		3.0-13.0	5.1-6.5	---
	23-34	0-6		0.0-5.0	5.1-6.5	---
	34-43	8-18		4.0-13.0	5.6-7.3	---
	43-60	5-15		2.0-12.0	5.6-7.3	---
759:						
Waukenabo-----	0-6	4-18		2.0-10.0	5.1-7.3	---
	6-15	2-14		2.0-10.0	5.1-7.3	---
	15-28	6-18		2.0-6.0	5.6-7.3	---
	28-30	4-14		4.0-9.0	7.4-8.4	5-30
	30-60	4-14		4.0-9.0	7.4-8.4	5-30
795:						
Redby-----	0-7	2-10		2.0-10.0	5.1-6.5	---
	7-25	1-8		1.0-5.0	5.1-6.5	---
	25-42	0-6		0.0-4.0	6.1-7.8	---
	42-60	2-15		1.0-7.0	6.1-7.8	0-15
797:						
Mooselake-----	0-3	---		150-180	4.5-7.3	---
	3-60	---		150-180	4.5-7.3	---
Lupton-----	0-8	---		100-200	4.5-7.8	---
	8-60	---		100-200	4.5-7.8	---
798:						
Sago-----	0-13	---		100-190	4.5-6.5	---
	13-60	6-18		4.0-18.0	5.6-8.4	0-20
Roscommon-----	0-6	0-12		8.0-40.0	5.6-7.8	---
	6-60	0-10		1.0-4.0	5.6-8.4	0-10
799:						
Seelyville-----	0-28	---		140-200	4.5-7.3	---
	28-60	---		140-200	4.5-7.3	---
Bowstring-----	0-38	0-5		80-190	5.6-8.4	0-25
	38-43	1-12		10.0-40.0	5.6-8.4	0-25
	43-60	0-5		80-190	5.6-8.4	0-25
869:						
Lobo-----	0-44	---		---	3.0-4.4	---
	44-60	---		---	3.0-4.4	---
Waskish-----	0-60	---		---	2.0-4.4	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
870B:					
Itasca-----	0-12	3-10	2.0-12.0	5.1-6.5	---
	12-16	3-10	2.0-8.0	5.1-6.0	---
	16-37	8-18	4.0-13.0	5.6-7.3	---
	37-60	8-15	3.0-10.0	6.6-8.4	0-10
Goodland-----	0-13	4-10	3.0-9.0	5.1-6.5	---
	13-30	8-18	4.0-9.0	5.1-6.5	---
	30-41	2-10	1.0-5.0	5.1-6.5	---
	41-60	0-5	0.0-2.0	5.6-7.8	---
870C:					
Itasca-----	0-4	3-10	2.0-12.0	5.1-6.5	---
	4-14	3-10	2.0-8.0	5.1-6.0	---
	14-49	8-18	4.0-13.0	5.6-7.3	---
	49-60	8-15	3.0-10.0	6.6-8.4	0-10
Goodland-----	0-12	4-10	3.0-9.0	5.1-6.5	---
	12-25	8-18	4.0-9.0	5.1-6.5	---
	25-33	2-10	1.0-5.0	5.1-6.5	---
	33-60	0-5	0.0-2.0	5.6-7.8	---
870E:					
Itasca-----	0-2	3-10	2.0-12.0	5.1-6.5	---
	2-14	3-10	2.0-8.0	5.1-6.0	---
	14-53	8-18	4.0-13.0	5.6-7.3	---
	53-60	8-15	3.0-10.0	6.6-8.4	0-10
Goodland-----	0-8	4-10	3.0-9.0	5.1-6.5	---
	8-23	8-18	4.0-9.0	5.1-6.5	---
	23-34	2-10	1.0-5.0	5.1-6.5	---
	34-60	0-5	0.0-2.0	5.6-7.8	---
872:					
Pengilly-----	0-4	12-18	9.0-19.0	5.6-7.3	---
	4-60	6-18	2.0-13.0	6.1-8.4	0-15
Winterfield-----	0-6	0-15	2.0-15.0	5.6-7.8	0-5
	6-41	0-15	1.0-10.0	5.6-7.8	0-5
	41-60	0-10	1.0-5.0	5.6-8.4	0-5
928C:					
Cushing-----	0-16	6-14	6.0-15.0	5.1-7.8	---
	16-19	4-16	3.0-15.0	5.1-7.8	---
	19-44	18-35	11.0-29.0	5.1-7.8	---
	44-60	8-21	5.0-18.0	5.1-8.4	0-10
Mahtomedi-----	0-4	2-15	2.0-11.0	5.1-6.5	---
	4-15	0-10	0.0-6.0	5.1-6.5	---
	15-26	0-10	0.0-6.0	5.1-6.5	---
	26-60	0-10	0.0-6.0	5.1-7.8	0-15
928D:					
Cushing-----	0-7	6-18	6.0-20.0	5.1-7.8	---
	7-17	4-16	3.0-15.0	5.1-7.8	---
	17-30	18-35	11.0-29.0	5.1-7.8	---
	30-60	8-21	5.0-18.0	5.1-8.4	0-10
Mahtomedi-----	0-3	2-15	2.0-11.0	5.1-6.5	---
	3-13	0-10	0.0-6.0	5.1-6.5	---
	13-25	0-10	0.0-6.0	5.1-6.5	---
	25-60	0-10	0.0-6.0	5.1-7.8	0-15

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
928F:					
Cushing-----	0-4	6-14	6.0-15.0	5.1-7.8	---
	4-14	4-16	3.0-15.0	5.1-7.8	---
	14-35	18-35	11.0-29.0	5.1-7.8	---
	35-60	8-21	5.0-18.0	5.1-8.4	0-10
Mahtomedi-----	0-4	2-15	2.0-11.0	5.1-6.5	---
	4-20	0-10	0.0-6.0	5.1-6.5	---
	20-35	0-10	0.0-6.0	5.1-6.5	---
	35-60	0-10	0.0-6.0	5.1-7.8	0-15
980:					
Blackhoof-----	0-10	---	50-100	5.1-6.5	---
	10-14	22-35	11.0-29.0	5.1-6.5	---
	14-60	22-35	9.0-22.0	5.1-7.8	0-5
Mahtowa-----	0-3	---	50-100	5.1-6.5	---
	3-11	18-35	10.0-20.0	6.1-7.3	---
	11-60	18-35	9.0-19.0	6.6-7.8	---
990:					
Twig-----	0-10	---	50-100	3.5-5.0	---
	10-16	8-18	5.0-21.0	3.5-5.5	---
	16-44	8-18	4.0-13.0	3.5-5.5	---
	44-52	8-18	3.0-12.0	3.5-5.5	---
	52-60	8-18	3.0-12.0	3.5-6.0	---
Giese-----	0-4	---	50-100	4.5-6.0	---
	4-10	8-27	11.0-30.0	4.5-6.0	---
	10-21	4-18	3.0-13.0	4.5-6.0	---
	21-43	6-20	4.0-15.0	5.1-6.5	---
	43-70	6-18	2.0-11.0	5.6-7.3	---
	70-80	6-18	2.0-11.0	5.6-7.3	---
1002:					
Borosapristis----	0-27	---	140-200	4.5-7.3	---
	27-48	---	140-200	4.5-7.3	---
	48-60	2-27	2.0-17.0	5.6-7.3	---
Fluvaquents-----	0-16	6-18	10.0-33.0	6.6-7.8	---
	16-60	10-27	8.0-17.0	6.6-7.8	0-5
1030:					
Pits.					
Udipsamments----	0-14	1-15	1.0-5.0	6.6-7.3	---
	14-60	1-10	1.0-3.0	6.6-7.3	---
	60-80	1-10	1.0-3.0	7.4-8.4	0-5
1031:					
Histosols-----	0-40	---	---	5.6-7.3	---
	40-60	0-5	0.0-5.0	5.6-7.3	---
1072:					
Udorthents.					
1115:					
Newson-----	0-6	4-12	9.0-30.0	3.5-7.3	---
	6-23	1-4	1.0-7.0	3.5-5.5	---
	23-60	1-4	0.0-4.0	4.5-6.5	---

## Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Cation- exchange capacity	Soil reaction	Calcium carbonate
	In	Pct	meq/100g	pH	Pct
1150: Jevne-----	0-6	6-15	15.0-20.0	5.1-7.3	---
	6-19	6-20	10.0-15.0	5.1-6.5	---
	19-43	18-35	15.0-20.0	5.6-7.3	---
	43-60	10-30	10.0-20.0	6.6-8.4	0-15
1154: Sax-----	0-12	0-1	50-140	5.1-6.5	---
	12-15	18-35	17.0-58.0	6.1-7.3	---
	15-39	18-35	12.0-30.0	6.1-7.3	---
	39-60	10-35	6.0-29.0	7.4-8.4	5-20
1353B: Cutaway-----	0-11	0-8	1.0-9.0	5.1-6.5	---
	11-26	0-8	1.0-7.0	5.1-6.5	---
	26-49	18-35	8.0-23.0	5.1-7.8	0-5
	49-60	18-30	7.0-22.0	6.1-8.4	5-20
1354A: Aftad-----	0-3	3-8	3.0-10.0	5.1-7.3	---
	3-25	3-12	2.0-10.0	4.5-6.5	---
	25-44	8-15	2.0-15.0	4.5-6.5	---
	44-60	1-12	0.0-10.0	5.1-6.5	---
1372: Wealthwood-----	0-4	0-15	5.0-10.0	4.5-5.5	---
	4-28	0-15	2.0-7.0	4.5-5.5	---
	28-42	12-27	10.0-20.0	5.1-6.0	---
	42-60	7-18	10.0-20.0	5.1-6.0	---
1375B: Alban-----	0-5	3-8	2.0-9.0	5.1-7.3	---
	5-23	3-15	2.0-10.0	5.1-7.3	---
	23-29	8-18	3.0-12.0	5.1-7.3	---
	29-60	1-12	0.0-8.0	5.1-7.3	---
1878: Hamre-----	0-10	---	160-200	5.1-7.8	0-5
	10-17	18-35	16.0-28.0	5.1-7.8	0-10
	17-60	18-35	10.0-22.0	7.4-8.4	5-30
1982: Baudette-----	0-4	10-27	8.0-30.0	5.6-7.3	---
	4-9	5-27	4.0-24.0	5.6-7.3	---
	9-21	18-35	12.0-30.0	5.6-7.8	0-5
	21-60	5-27	3.0-23.0	7.4-8.4	10-20
Spooner-----	0-7	10-24	6.0-22.0	5.6-7.8	0-15
	7-22	3-18	1.0-11.0	5.6-7.8	0-15
	22-27	18-35	11.0-21.0	6.1-7.8	0-15
	27-60	5-32	2.0-20.0	7.4-8.4	10-40
1983: Cathro-----	0-16	---	100-190	4.5-6.5	---
	16-35	---	100-190	4.5-6.5	---
	35-60	6-30	0.0-10.0	5.6-8.4	---
1984: Leafriver-----	0-13	---	100-180	4.5-7.3	---
	13-17	3-18	10.0-50.0	4.5-7.3	---
	17-60	0-10	1.0-15.0	4.5-7.3	---

## Water Features

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
72: Shooker-----	C	None-----	---	---	0.5-1.5	Apparent---	Nov-Jul
119C: Pomroy-----	C	None-----	---	---	>6.0	---	---
124: Brickton-----	C	None-----	---	---	0.5-1.5	Apparent---	Oct-Jun
133B: Dalbo-----	B	None-----	---	---	2.5-5.0	Apparent---	Nov-May
142: Nokay-----	C	None-----	---	---	1.0-2.5	Perched----	Apr-Jun
144B: Flak-----	C	None-----	---	---	3.5-4.0	Perched----	Apr-May
144C: Flak-----	C	None-----	---	---	>6.0	---	---
146B: Wabedo-----	C	None-----	---	---	2.0-3.5	Perched----	Apr-Jun
147: Spooner-----	C/D	None-----	---	---	0.5-1.5	Apparent---	Nov-Jul
152B: Milaca-----	C	None-----	---	---	3.0-5.0	Perched----	Apr-May
152C, 152E: Milaca-----	C	None-----	---	---	>6.0	---	---
164B: Mora-----	C	None-----	---	---	2.0-3.5	Perched----	Mar-Jun
166: Ronneby-----	C	None-----	---	---	1.0-2.0	Perched----	Oct-Jun
167B: Baudette-----	B	None-----	---	---	2.5-4.0	Apparent---	Apr-Jun
186: Nemadji-----	B	None-----	---	---	1.5-3.0	Apparent---	Mar-Jun
188B, 188C, 188E: Omega-----	A	None-----	---	---	>6.0	---	---
202: Meehan-----	B	None-----	---	---	1.0-2.5	Apparent---	Oct-Jun
204B: Branstad-----	B	None-----	---	---	2.5-3.5	Perched----	Oct-May
204C, 204E: Cushing-----	B	None-----	---	---	>6.0	---	---

## Water Features--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
					<u>Ft</u>		
218: Watab-----	C	None-----	---	---	0.0-1.0	Perched---	Mar-Jun
240B: Warba-----	B	None-----	---	---	3.5-6.0	Apparent---	Apr-May
240C: Warba-----	B	None-----	---	---	>6.0	---	---
243: Stuntz-----	C	None-----	---	---	1.5-3.0	Apparent---	Mar-Jun
266: Freer-----	C	None-----	---	---	1.0-2.0	Perched---	Nov-Jun
268B, 268C, 268E, 268F: Cromwell-----	A	None-----	---	---	>6.0	---	---
292: Alstad-----	C	None-----	---	---	1.0-2.5	Perched---	Sep-May
302B, 302C: Rosholt-----	B	None-----	---	---	>6.0	---	---
346: Talmoon-----	C	None-----	---	---	0.5-1.5	Apparent---	Nov-Jun
428: Hassman-----	D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jun
454B, 454C, 454E, 454F: Mahtomedi-----	A	None-----	---	---	>6.0	---	---
458B, 458C, 458E: Menahga-----	A	None-----	---	---	>6.0	---	---
464B: Brennyville-----	C	None-----	---	---	2.0-3.5	Perched---	Nov-May
469B: Hillcity-----	B	None-----	---	---	3.5-6.0	Apparent---	Apr-May
502: Dusler-----	C	None-----	---	---	1.5-2.5	Apparent---	Apr-Jun
504B: Duluth-----	B	None-----	---	---	3.5-6.0	Apparent---	Apr-May
504C, 504E: Duluth-----	B	None-----	---	---	>6.0	---	---
531: Beseman-----	A/D	None-----	---	---	+2.0-0.0	Apparent---	Jan-Dec
532: Sago-----	D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jul
533: Loxley-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Oct-May

## Water Features--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
					<u>Ft</u>		
540: Seelyeville-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jun
541: Rifle-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Nov-Jun
543: Markey-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Nov-Jun
544: Cathro-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jun
546: Lupton-----	A/D	None-----	---	---	0.0-1.0	Apparent---	Sep-May
549: Greenwood-----	A/D	None-----	---	---	0.0-1.0	Apparent---	Sep-Jun
563: Northwood-----	B/D	None-----	---	---	+1.0-0.0	Apparent---	Nov-Jul
564: Friendship-----	A	None-----	---	---	3.5-6.0	Apparent---	Oct-Jun
607: Pengilly-----	B/D	Frequent---	Brief-----	Apr-Oct	0.5-1.5	Apparent---	Jan-Dec
615: Cowhorn-----	B	None-----	---	---	1.5-2.5	Apparent---	Apr-Jun
617B: Goodland-----	B	None-----	---	---	>6.0	---	---
618B: Itasca-----	B	None-----	---	---	>6.0	---	---
621: Morph-----	B/D	None-----	---	---	0.5-1.5	Apparent---	Oct-Jun
625: Sandwick-----	B	None-----	---	---	0.5-1.5	Apparent---	Apr-Jun
627: Tawas-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Oct-May
628: Talmoon-----	D	None-----	---	---	+1.0-0.0	Apparent---	Nov-Jun
629B: Wawina-----	A	None-----	---	---	>6.0	---	---
672: Willossippi-----	C	None-----	---	---	0.5-1.5	Apparent---	Oct-Jun
685: Oesterle-----	C	None-----	---	---	1.0-3.0	Apparent---	Oct-Jun
732B: Bushville-----	C	None-----	---	---	1.5-2.5	Perched---	Mar-Jun
734: Cormant-----	A/D	None-----	---	---	0.5-1.5	Apparent---	Apr-Jul

## Water Features--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth	Kind of water table	Months
					Ft		
736: Ronneby-----	C	None-----	---	---	1.0-2.0	Perched----	Oct-Jun
Mora-----	C	None-----	---	---	2.0-3.5	Perched----	Mar-Jun
738B: Milaca-----	C	None-----	---	---	3.0-5.0	Perched----	Apr-May
Millward-----	B	None-----	---	---	>6.0	---	---
738C: Milaca-----	C	None-----	---	---	>6.0	---	---
Millward-----	B	None-----	---	---	>6.0	---	---
759: Waukenabo-----	B/D	None-----	---	---	0.5-1.5	Apparent----	Oct-Jun
795: Redby-----	B	None-----	---	---	1.5-2.5	Apparent----	Apr-Jul
797: Mooselake-----	A/D	None-----	---	---	+1.0-0.0	Apparent----	Jan-Dec
Lupton-----	A/D	None-----	---	---	0.0-1.0	Apparent----	Sep-May
798: Sago-----	D	None-----	---	---	+1.0-0.0	Apparent----	Oct-Jul
Roscommon-----	A/D	None-----	---	---	+1.0-0.0	Apparent----	Sep-Jun
799: Seelyeville-----	A/D	Frequent----	Long-----	Nov-May	+1.0-0.0	Apparent----	Oct-Jun
Bowstring-----	A/D	Frequent----	Long-----	Mar-Jun	+1.0-0.0	Apparent----	Oct-Jun
869: Lobo-----	D	None-----	---	---	0.0-2.0	Apparent----	Jan-Dec
Waskish-----	D	None-----	---	---	0.0-2.0	Apparent----	Nov-Jul
870B, 870C, 870E: Itasca-----	B	None-----	---	---	>6.0	---	---
Goodland-----	B	None-----	---	---	>6.0	---	---
872: Pengilly-----	B/D	Frequent----	Brief-----	Apr-Oct	0.5-1.5	Apparent----	Jan-Dec
Winterfield-----	A/D	Frequent----	Brief-----	Nov-May	0.5-3.0	Apparent----	Nov-May
928C, 928D, 928F: Cushing-----	B	None-----	---	---	>6.0	---	---
Mantomedi-----	A	None-----	---	---	>6.0	---	---
980: Biackhoof-----	D	None-----	---	---	+1.0-0.0	Apparent----	Jan-Dec
Mahtowa-----	C/D	None-----	---	---	+1.0-0.0	Apparent----	Oct-Jul

## Water Features--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table		
		Frequency	Duration	Months	Water table depth Ft	Kind of water table	Months
990:							
Twig-----	D	None-----	---	---	+1.0-0.0	Perched----	Sep-Jul
Giese-----	D	None-----	---	---	+1.0-0.0	Perched----	Jan-Dec
1002:							
Borosaprists----	D	Frequent----	Long-----	Mar-Jul	0.0-3.0	Apparent---	Jan-Dec
Fluvaquents----	D	Frequent----	Long-----	Mar-Jul	0.0-1.0	Apparent---	Mar-Feb
1030:							
Pits.							
Udipsamments----	A	None-----	---	---	>6.0	---	---
1031:							
Histosols-----	D	None-----	---	---	+2.0-0.0	Apparent---	Nov-Jun
1072:							
Udorthents.							
1115:							
Newson-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Apr-Jun
1150:							
Jevne-----	C	None-----	---	---	0.5-1.5	Apparent---	Nov-Jun
1154:							
Sax-----	D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jul
1353B:							
Cutaway-----	B	None-----	---	---	3.5-6.0	Perched----	Apr-May
1354A:							
Aftad-----	B	None-----	---	---	2.5-3.5	Perched----	Sep-Jun
1372:							
Wealthwood-----	A/D	None-----	---	---	0.5-1.5	Apparent---	Apr-Jun
1375B:							
Alban-----	B	None-----	---	---	>6.0	---	---
1878:							
Hamre-----	C/D	None-----	---	---	+1.0-0.0	Apparent---	Jan-Dec
1982:							
Baudette-----	B	None-----	---	---	2.5-4.0	Apparent---	Apr-Jun
Spoooner-----	C/D	Rare-----	---	---	0.5-1.5	Apparent---	Nov-Jul
1983:							
Cathro-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Oct-Jun
1984:							
Leafriver-----	A/D	None-----	---	---	+1.0-0.0	Apparent---	Nov-Jul

## Soil Features

(Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
72: Shooker-----	>60	---	---	---	High-----	High-----	Low.
119C: Pomroy-----	>60	---	---	---	Low-----	Moderate---	Low.
124: Brickton-----	>60	---	---	---	High-----	High-----	Moderate.
133B: Dalbo-----	>60	---	---	---	High-----	High-----	Moderate.
142: Nokay-----	>60	---	---	---	High-----	Moderate---	High.
144B, 144C: Flak-----	>60	---	---	---	Moderate---	Low-----	Moderate.
146B: Wabedo-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
147: Spooner-----	>60	---	---	---	High-----	High-----	Low.
152B, 152C, 152E: Milaca-----	>60	---	---	---	Moderate---	Low-----	Moderate.
164B: Mora-----	>60	---	---	---	High-----	Moderate---	Moderate.
166: Ronneby-----	>60	---	---	---	High-----	Moderate---	Moderate.
167B: Baudette-----	>60	---	---	---	High-----	Moderate---	Low.
186: Nemadji-----	>60	---	---	---	Moderate---	Moderate---	High.
188B, 188C, 188E: Omega-----	>60	---	---	---	Low-----	Low-----	Moderate.
202: Meehan-----	>60	---	---	---	Moderate---	Low-----	Moderate.
204B: Branstad-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
204C, 204E: Cushing-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
218: Watab-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
240B, 240C: Warba-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
243: Stuntz-----	>60	---	---	---	High-----	High-----	Moderate.

## Soil Features--Continued

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
266: Freer-----	>60	---	---	---	High-----	High-----	Moderate.
268B, 268C, 268E, 268F: Cromwell-----	>60	---	---	---	Low-----	Low-----	Moderate.
292: Alstad-----	>60	---	---	---	High-----	Moderate---	Moderate.
302B, 302C: Rosholt-----	>60	---	---	---	Moderate---	Low-----	Moderate.
346: Talmoon-----	>60	---	---	---	High-----	High-----	Moderate.
428: Hassman-----	>60	---	---	---	High-----	High-----	Low.
454B, 454C, 454E, 454F: Mahtomedi-----	>60	---	---	---	Low-----	Low-----	High.
458B, 458C, 458E: Menahga-----	>60	---	---	---	Low-----	Low-----	Moderate.
464B: Brennyville-----	>60	---	---	---	High-----	Moderate---	Moderate.
469B: Hillcity-----	>60	---	---	---	Moderate---	Low-----	Moderate.
502: Dusler-----	>80	---	---	---	High-----	High-----	Moderate.
504B: Duluth-----	>60	---	---	---	Moderate---	High-----	Low.
504C, 504E: Duluth-----	>60	---	---	---	Moderate---	Moderate---	Low.
531: Beseman-----	>60	---	---	12-36	High-----	High-----	High.
532: Sago-----	>60	---	---	5-10	High-----	High-----	Moderate.
533: Loxley-----	>60	---	6-18	50-55	High-----	High-----	High.
540: Seelyville-----	>60	---	---	50-55	High-----	High-----	Moderate.
541: Rifle-----	>60	---	---	---	High-----	High-----	Low.
543: Markey-----	>60	---	---	25-30	High-----	High-----	Low.
544: Cathro-----	>60	---	---	19-22	High-----	High-----	Low.
546: Lupton-----	>60	---	6-18	50-55	High-----	High-----	Low.

## Soil Features--Continued

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
549: Greenwood-----	>60	---	6-18	55-60	High-----	High-----	High.
563: Northwood-----	>60	---	0-3	8-10	High-----	High-----	Low.
564: Friendship-----	>60	---	---	---	Low-----	Low-----	High.
607: Pengilly-----	>60	---	---	---	High-----	High-----	Moderate.
615: Cownhorn-----	>60	---	---	---	High-----	Moderate---	Moderate.
617B: Goodland-----	>60	---	---	---	Moderate---	Low-----	Moderate.
618B: Itasca-----	>60	---	---	---	Moderate---	Low-----	Moderate.
621: Morph-----	>60	---	---	---	High-----	Moderate---	Low.
625: Sandwick-----	>60	---	---	---	Moderate---	High-----	Moderate.
627: Tawas-----	>60	---	4-15	25-30	High-----	High-----	Moderate.
628: Talmoon-----	>60	---	---	---	High-----	High-----	Moderate.
629B: Wawina-----	>60	---	---	---	Moderate---	Low-----	Moderate.
672: Willossippi-----	>60	---	---	---	High-----	High-----	Moderate.
685: Oesterle-----	>60	---	---	---	High-----	Low-----	Moderate.
732B: Bushville-----	>60	---	---	---	Low-----	Moderate---	Moderate.
734: Cormant-----	>60	---	---	---	Moderate---	High-----	Low.
736: Ronneby-----	>60	---	---	---	High-----	Moderate---	Moderate.
Mora-----	>60	---	---	---	High-----	Moderate---	Moderate.
738B, 738C: Milaca-----	>60	---	---	---	Moderate---	Low-----	Moderate.
Millward-----	>60	---	---	---	Low-----	Low-----	Moderate.
759: Waukenabo-----	>60	---	---	---	High-----	Low-----	Moderate.
795: Redby-----	>60	---	---	---	Moderate---	Low-----	Low.

## Soil Features--Continued

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
797: Mooselake-----	>60	---	0-12	12-30	High-----	High-----	High.
Lupton-----	>60	---	6-18	50-55	High-----	High-----	Low.
798: Sago-----	>60	---	---	5-10	High-----	High-----	Moderate.
Roscommon-----	>60	---	---	---	Moderate---	High-----	Low.
799: Seelyville-----	>60	---	---	50-55	High-----	High-----	Moderate.
Bowstring-----	>60	---	---	20-30	High-----	High-----	Low.
869: Lobo-----	>60	---	---	55-50	High-----	High-----	High.
Waskish-----	>60	---	---	---	High-----	High-----	High.
870B, 870C, 870E: Itasca-----	>60	---	---	---	Moderate---	Low-----	Moderate.
Goodland-----	>60	---	---	---	Moderate---	Low-----	Moderate.
872: Pengilly-----	>60	---	---	---	High-----	High-----	Moderate.
Winterfield-----	>60	---	---	---	Moderate---	Low-----	Low.
928C, 928D, 928F: Cushing-----	>60	---	---	---	Moderate---	Moderate---	Moderate.
Mahtomedi-----	>60	---	---	---	Low-----	Low-----	High.
980: Blackhoof-----	>60	---	---	---	High-----	High-----	Moderate.
Mahtowa-----	>60	---	---	---	High-----	High-----	Moderate.
990: Twig-----	>60	---	0-6	6-12	High-----	High-----	High.
Giese-----	>60	---	---	---	High-----	High-----	High.
1002: Borosaprists-----	>60	---	---	---	High-----	High-----	Moderate.
Fluvaquents-----	>60	---	---	---	High-----	High-----	Low.
1030: Pits.							
Udipsamments-----	>60	---	---	---	Low-----	Low-----	Low.
1031: Histosols-----	>60	---	12-20	20-40	High-----	High-----	Moderate.
1072: Udorthents.							
1115: Newson-----	>60	---	---	---	Moderate---	High-----	High.

## Soil Features--Continued

Soil name and map symbol	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	<u>In</u>		<u>In</u>	<u>In</u>			
1150: Jevne-----	>60	---	---	---	High-----	High-----	Moderate.
1154: Sax-----	>60	---	---	5-10	High-----	High-----	Moderate.
1353B: Cutaway-----	>60	---	---	---	Low-----	Moderate----	Moderate.
1354A: Aftad-----	>60	---	---	---	Moderate----	Low-----	Moderate.
1372: Wealthwood-----	>60	---	---	---	Low-----	High-----	High.
1375B: Alban-----	>60	---	---	---	Moderate----	Low-----	Moderate.
1878: Hamre-----	>60	---	---	---	High-----	High-----	Low.
1982: Baudette-----	>60	---	---	---	High-----	Moderate----	Low.
Spoooner-----	>60	---	---	---	High-----	High-----	Low.
1983: Cathro-----	>60	---	8-20	16-45	High-----	High-----	Moderate.
1984: Leafriver-----	>60	---	---	5-10	High-----	High-----	High.

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# Glossary

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

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

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

**Aspect.** The direction in which a slope faces.

**Association, soil.** A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low .....	0 to 3
Low .....	3 to 6
Moderate .....	6 to 9
High .....	9 to 12
Very high .....	more than 12

**Backslope.** The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.

**Basal till.** Compact glacial till deposited beneath the ice.

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

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

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

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

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

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

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

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

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

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

**Capillary water.** Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

**Catena.** A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Cation-exchange capacity.** The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

**Chiseling.** Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Coarse textured soil.** Sand or loamy sand.

**Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

**Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

**Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Concretions.** Grains, pellets, or nodules of various

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

**Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

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

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

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

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

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

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

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping (or contour farming).**

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

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

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cropping system.** Growing crops according to a planned system of rotation and management practices.

**Crop residue management.** Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

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

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

**Dense layer** (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

**Depth, soil.** The thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

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

*Excessively drained.*—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

*Somewhat excessively drained.*—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

*Well drained.*—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

*Moderately well drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

*Somewhat poorly drained.*—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

*Poorly drained.*—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

*Very poorly drained.*—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

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

**Endosaturation.** A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

**Ephemeral stream.** A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

**Episaturation.** A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as

flood plains and coastal plains. Synonym: natural erosion.

**Erosion (accelerated).** Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

**Erosion pavement.** A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

**Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

**Excess fines (in tables).** Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Excess lime (in tables).** Excess carbonates in the soil that restrict the growth of some plants.

**Fast intake (in tables).** The rapid movement of water into the soil.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

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

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

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

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

**Footslope.** The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. The surface is dominantly concave. In terms of gradational processes, a footslope is a transition zone between an upslope site of erosion (backslope) and a downslope site of deposition (toeslope).

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

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

**Frost action (in tables).** Freezing and thawing of soil

moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Geomorphology.** The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

**Glacial drift.** Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

**Glacial outwash.** Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

**Glaciofluvial deposits.** Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

**Glaciolacustrine deposits.** Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

**Green manure crop (agronomy).** A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

**Ground water.** Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily

runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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

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

**High-residue crops.** Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

**Hill.** A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

*C horizon.*—The mineral horizon or layer,

excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

*Cr horizon.*—Soft, consolidated bedrock beneath the soil.

*R layer.*—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

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

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

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

**Igneous rock.** Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Infiltration capacity.** The maximum rate at which water can infiltrate into a soil under a given set of conditions.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

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

**Intermittent stream.** A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

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

**Iron depletions.** Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

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

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

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

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

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

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

**Landslide.** The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

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

**Low-residue crops.** Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

**Low strength.** The soil is not strong enough to support loads.

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

**Masses.** Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

**Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Mineral soil.** Soil that is mainly mineral material and

low in organic material. Its bulk density is more than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Moderately coarse textured soil.** Coarse sandy loam, sandy loam, or fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, or silty clay loam.

**Mollic epipedon.** A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

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

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common, and many*; size—*fine, medium, and coarse*; and contrast—*faint, distinct, and prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

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

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nodules.** Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly

nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low .....	less than 0.5 percent
Low .....	0.5 to 1.0 percent
Moderately low .....	1.0 to 2.0 percent
Moderate .....	2.0 to 4.0 percent
High .....	4.0 to 8.0 percent
Very high .....	more than 8.0 percent

**Outwash plain.** An extensive area of glaciofluvial material that was deposited by meltwater streams.

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

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

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The movement of water through the soil.

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

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

Extremely slow .....	less than 0.01 inch
Very slow .....	0.01 to 0.06 inch
Slow .....	0.06 to 0.2 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on

features that affect its use and management, such as slope, stoniness, and thickness.

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

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

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

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

**Plateau.** An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

**Plowpan.** A compacted layer formed in the soil directly below the plowed layer.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

**Poorly graded.** Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

**Poor outlets** (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

**Potential native plant community.** See Climax plant community.

**Potential rooting depth (effective rooting depth).**

Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline.

The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid .....	less than 4.5
Very strongly acid .....	4.5 to 5.0
Strongly acid .....	5.1 to 5.5
Moderately acid .....	5.6 to 6.0
Slightly acid .....	6.1 to 6.5
Neutral .....	6.6 to 7.3
Slightly alkaline .....	7.4 to 7.8
Moderately alkaline .....	7.9 to 8.4
Strongly alkaline .....	8.5 to 9.0
Very strongly alkaline .....	9.1 and higher

**Redoximorphic concentrations.** Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

**Redoximorphic depletions.** Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

**Redoximorphic features.** Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

**Reduced matrix.** A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

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

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

**Rock fragments.** Rock or mineral fragments having

- a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.
- Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.
- Root zone.** The part of the soil that can be penetrated by plant roots.
- Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.
- Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.
- Sandstone.** Sedimentary rock containing dominantly sand-sized particles.
- Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.
- Saturation.** Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.
- Scarification.** The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.
- Second bottom.** The first terrace above the normal flood plain (or first bottom) of a river.
- Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.
- Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.
- Sequum.** A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)
- Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.
- Shale.** Sedimentary rock formed by the hardening of a clay deposit.
- Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.
- Shoulder.** The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in origin.
- Shrink-swell** (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.
- Silica.** A combination of silicon and oxygen. The mineral form is called quartz.
- Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.
- Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.
- Slippage** (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.
- Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.
- Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
- Sloughed till.** Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.
- Slow intake** (in tables). The slow movement of water into the soil.
- Slow refill** (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.
- Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soft bedrock.** Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand .....	2.0 to 1.0
Coarse sand .....	1.0 to 0.5
Medium sand .....	0.5 to 0.25
Fine sand .....	0.25 to 0.10
Very fine sand .....	0.10 to 0.05
Silt .....	0.05 to 0.002
Clay .....	less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

**Stone line.** A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are

either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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

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

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

**Substratum.** The part of the soil below the solum.

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

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

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

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

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

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

**Thin layer** (in tables). Otherwise suitable soil material too thin for the specified use.

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

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

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

**Toeslope.** The outermost inclined surface at the base of a hill. Toeslopes are commonly gentle and linear in profile.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Toxicity** (in tables). Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.

**Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in

soils in extremely small amounts. They are essential to plant growth.

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

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

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

**Variation.** Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

**Varve.** A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Well graded.** Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

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

# Accessibility Statement

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