United States Department of Agriculture

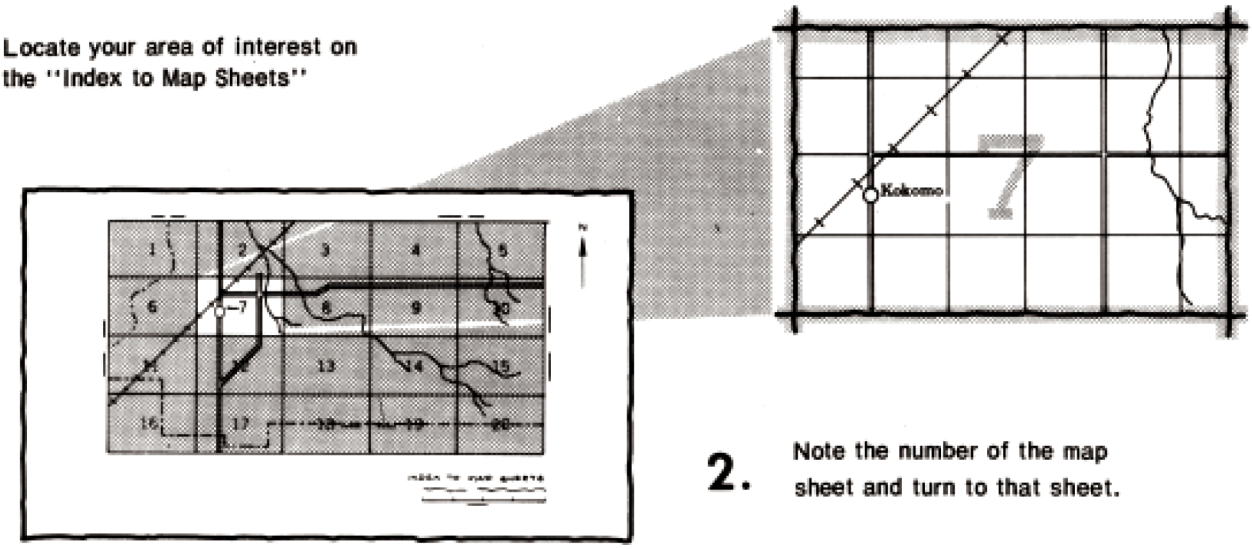
Soil Conservation Service

In cooperation with the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa

Soil Survey of Monroe County, Iowa

HOW TO USE

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



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

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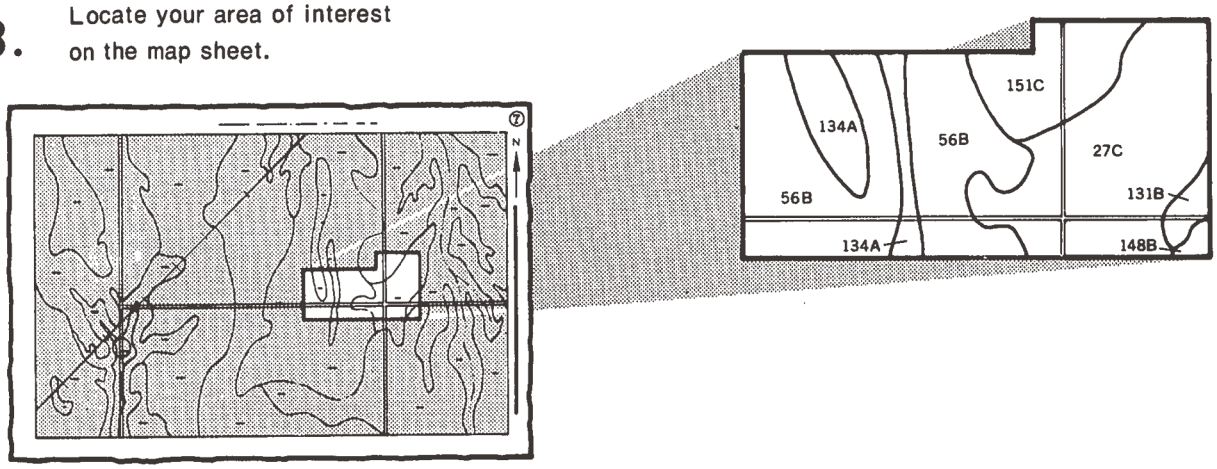

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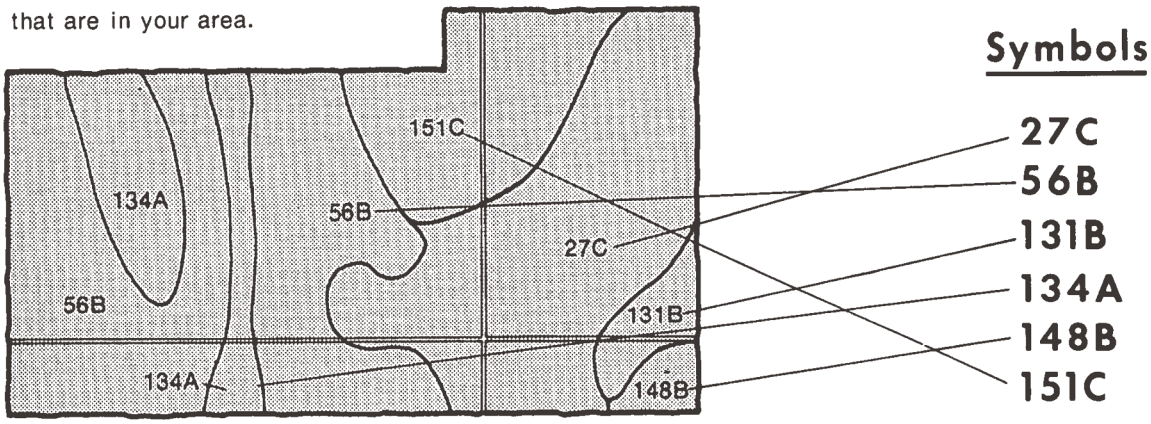
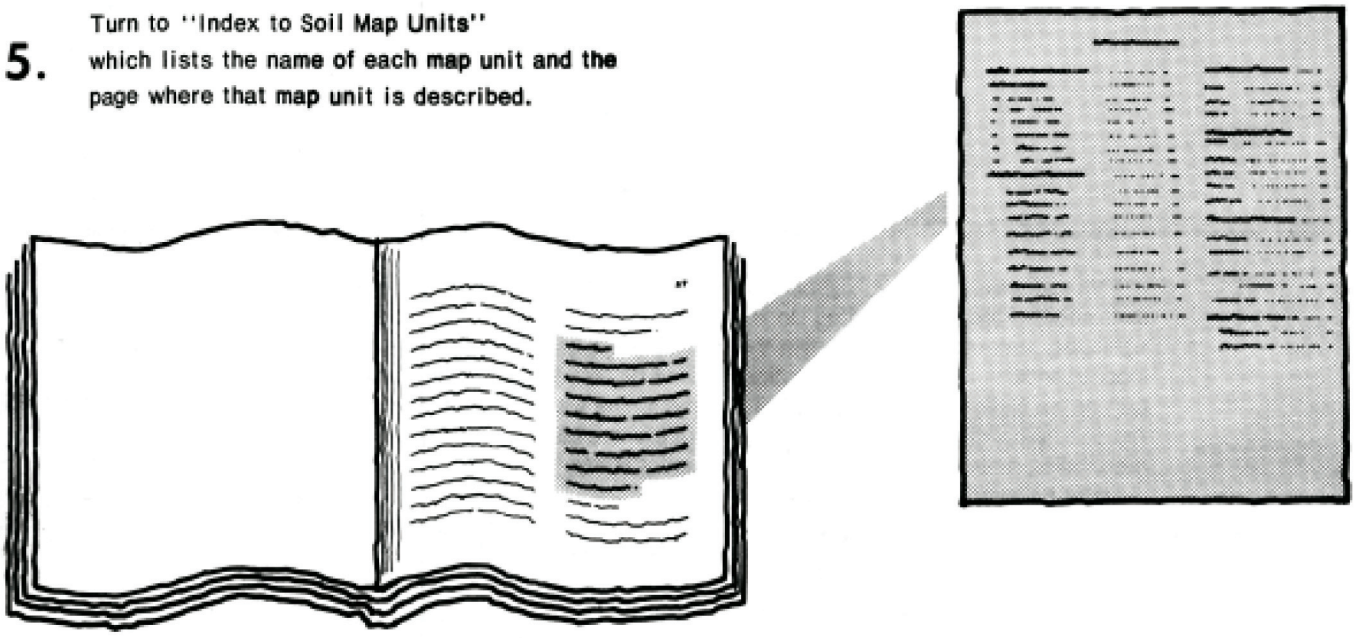
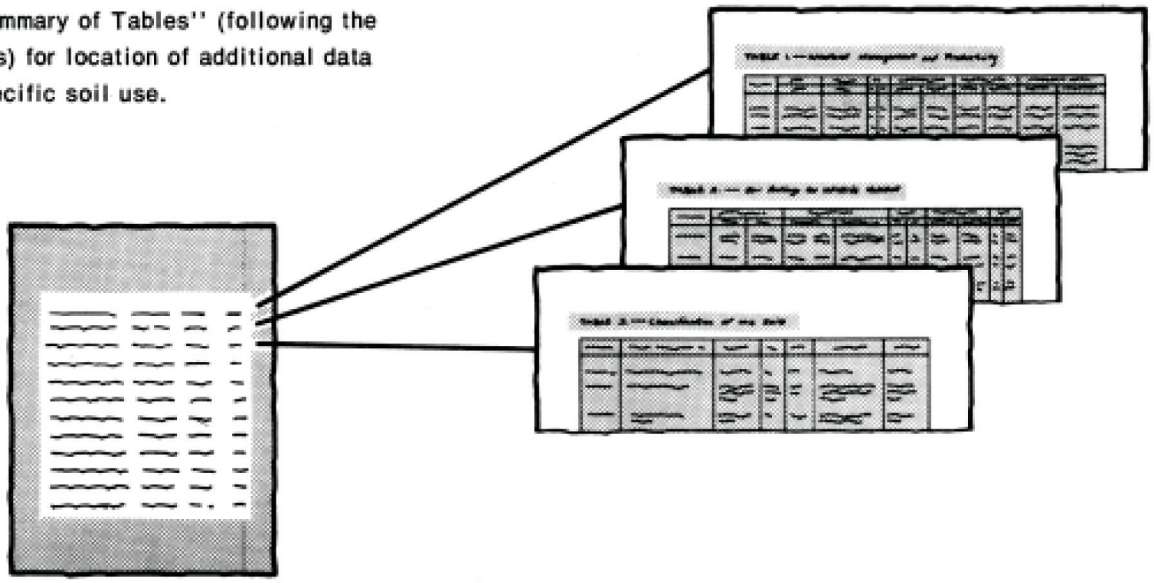


THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1977-81. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service; the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Monroe County Soil Conservation District. Funds appropriated by Monroe County were used to defray part of the cost of the survey.

Cover: An area of Ladoga silt loam, 5 to 9 percent slopes, used for hay.

Contents

Index to map units iv
Summary of tables vi
Preface ix
General nature of the county 1
How this survey was made 3
Map unit composition 3
General soil map units 5
Soil descriptions 5
Detailed soil map units 13
Soil descriptions 13
Prime farmland 62
Use and management of the soils 65
Crops and pasture 65
Woodland management and productivity 68
Windbreaks and environmental plantings 69
Recreation 69
Wildlife habitat 70
Engineering 72
Soil properties 77
Engineering index properties 77
Physical and chemical properties 78
Soil and water features 79
Classification of the soils 81
Soil series and their morphology 81
Formation of the soils 107
Factors of soil formation 107
Processes of horizon differentiation 110
References 113
Glossary 115
Tables 123

Soil Series

Adair series 81
Arispe series 82
Armstrong series 83
Ashgrove series 83
Beckwith series 84
Belinda series 85
Bucknell series 85
Clarinda series 86
Clinton series 87
Colo series 87
Douds series 88
Edina series 89
Ely series 89
Galland series 90
Gara series 90
Gosport series 91
Grundy series 92
Haig series 92
Keswick series 93
Koszta series 94
Ladoga series 94
Lamoni series 95
Lawson series 96
Lindley series 96
Lineville series 97
Mahaska series 98
Nodaway series 98
Okaw series 99
Olmitz series 99
Otley series 100
Pershing series 101
Rinda series 101
Shelby series 102
Sparta series 103
Taintor series 103
Vanmeter series 104
Vesser series 104
Weller series 105
Zook series 106

Issued September 1984

Index to Map Units

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes 13
13B—Olmitz-Colo-Vesser complex, 2 to 5 percent slopes 14
23C—Arispe silty clay loam, 5 to 9 percent slopes 14
23C2—Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded 15
24D2—Shelby clay loam, 9 to 14 percent slopes, moderately eroded 15
24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded 16
41D—Sparta loamy fine sand, 5 to 14 percent slopes 16
51—Vesser silt loam, 0 to 2 percent slopes 16
54—Zook silty clay loam, 0 to 2 percent slopes 17
54+—Zook silt loam, overwash, 0 to 2 percent slopes 17
58D2—Douds loam, 9 to 14 percent slopes, moderately eroded 17
58E2—Douds loam, 14 to 18 percent slopes, moderately eroded 18
65D—Lindley loam, 9 to 14 percent slopes 18
65E—Lindley loam, 14 to 18 percent slopes 19
65E2—Lindley loam, 14 to 18 percent slopes, moderately eroded 19
65G—Lindley loam, 18 to 40 percent slopes 20
76B—Ladoga silt loam, 2 to 5 percent slopes 20
76C—Ladoga silt loam, 5 to 9 percent slopes 21
76C2—Ladoga silt loam, 5 to 9 percent slopes, moderately eroded 22
76D—Ladoga silt loam, 9 to 14 percent slopes 22
76D2—Ladoga silt loam, 9 to 14 percent slopes, moderately eroded 23
80D—Clinton silt loam, 9 to 14 percent slopes 23
80D2—Clinton silty clay loam, 9 to 14 percent slopes, moderately eroded 24
130—Belinda silt loam, 0 to 2 percent slopes 24
131B—Pershing silt loam, 2 to 5 percent slopes 24
131C—Pershing silt loam, 5 to 9 percent slopes 25
132B—Weller silt loam, 2 to 5 percent slopes 25
132C—Weller silt loam, 5 to 9 percent slopes 26
133—Colo silty clay loam, 0 to 2 percent slopes 26
133B—Colo silty clay loam, 2 to 5 percent slopes 28
133+—Colo silt loam, overwash, 0 to 2 percent slopes 28
179D2—Gara loam, 9 to 14 percent slopes, moderately eroded 28
179E2—Gara loam, 14 to 18 percent slopes, moderately eroded 29
179F—Gara loam, 18 to 25 percent slopes 29
179F2—Gara loam, 18 to 25 percent slopes, moderately eroded 30
192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded 30
211—Edina silt loam, 0 to 1 percent slopes 31
220—Nodaway silt loam, 0 to 2 percent slopes 31
222C—Clarinda silty clay loam, 5 to 9 percent slopes 31
222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded 32
222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded 32
223C2—Rinda silty clay loam, 5 to 9 percent slopes, moderately eroded 33
223D2—Rinda silty clay loam, 9 to 14 percent slopes, moderately eroded 34
260—Beckwith silt loam, 0 to 2 percent slopes 34
263—Okaw silt loam, 0 to 2 percent slopes 35
273C—Olmitz loam, 5 to 9 percent slopes 35
279—Taintor silt loam, 0 to 2 percent slopes 35
280—Mahaska silty clay loam, 0 to 2 percent slopes 36
281B—Otley silty clay loam, 2 to 5 percent slopes 36
281C—Otley silty clay loam, 5 to 9 percent slopes 37
281C2—Otley silty clay loam, 5 to 9 percent slopes, moderately eroded 38
313D—Gosport silt loam, 9 to 14 percent slopes 39
313D2—Gosport silt loam, 9 to 14 percent slopes, moderately eroded 39
313E—Gosport silt loam, 14 to 18 percent slopes 40
313E2—Gosport silt loam, 14 to 18 percent slopes, moderately eroded 40
313F—Gosport silt loam, 18 to 25 percent slopes 41
362—Haig silty clay loam, 0 to 2 percent slopes 41
364B—Grundy silty clay loam, 2 to 5 percent slopes 42
419D2—Vanmeter silty clay loam, 9 to 14 percent slopes, moderately eroded 42
419E2—Vanmeter silty clay loam, 14 to 18 percent slopes, moderately eroded 43
423D2—Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded 43
424E2—Lindley-Keswick loams, 14 to 18 percent slopes, moderately eroded 44
425C—Keswick loam, 5 to 9 percent slopes 44
425D—Keswick loam, 9 to 14 percent slopes 45
425D2—Keswick loam, 9 to 14 percent slopes, moderately eroded 45
428B—Ely silty clay loam, 2 to 5 percent slopes 46

452C—Lineville silt loam, 5 to 9 percent slopes 46
478G—Gosport-Rock outcrop complex, 14 to 40 percent slopes 47
484—Lawson silt loam, 0 to 2 percent slopes 48
594C2—Galland loam, 5 to 9 percent slopes, moderately eroded 48
594D2—Galland loam, 9 to 14 percent slopes, moderately eroded 49
688—Koszta silt loam, 0 to 2 percent slopes 50
731C2—Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded 50
731D2—Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded 52
732C2—Weller silty clay loam, 5 to 9 percent slopes, moderately eroded 52
732D2—Weller silty clay loam, 9 to 14 percent slopes, moderately eroded 53
792C2—Armstrong loam, 5 to 9 percent slopes, moderately eroded 54
792D2—Armstrong loam, 9 to 14 percent slopes, moderately eroded 54
795D—Ashgrove silt loam, 9 to 14 percent slopes 55
822D2—Lamoni clay loam, 9 to 14 percent slopes, moderately eroded 55
832C2—Weller silty clay loam, benches, 5 to 9 percent slopes, moderately eroded 56
876B—Ladoga silt loam, benches, 2 to 5 percent slopes 56
876C2—Ladoga silt loam, benches, 5 to 9 percent slopes, moderately eroded 57
993D2—Gara-Armstrong loams, 9 to 14 percent slopes, moderately eroded 57
993E2—Gara-Armstrong loams, 14 to 18 percent slopes, moderately eroded 58
1130—Belinda silt loam, benches, 0 to 2 percent slopes 59
1131C—Pershing silt loam, benches, 5 to 9 percent slopes 59
1279—Taintor silt loam, benches, 0 to 2 percent slopes 60
5020—Pits and Dumps 61
5021—Orthents, hilly 61
5030—Pits, quarries 62
5040—Orthents, loamy 62

Summary of Tables

Temperature and precipitation (table 1) 124

Freeze dates in spring and fall (table 2) 125
Probability. Temperature.

Growing season (table 3) 125

Acreage and proportionate extent of the soils (table 4) 126
Acres. Percent.

Prime farmland (table 5) 127

Yields per acre of crops and pasture (table 6) 128
Corn. Soybeans. Oats. Grass-legume hay. Kentucky bluegrass. Smooth bromegrass. Bromegrass-alfalfa.

Capability classes and subclasses (table 7) 132
Total acreage. Major management concerns.

Woodland management and productivity (table 8) 133
Ordination symbol. Management concerns. Potential productivity. Trees to plant.

Windbreaks and environmental plantings (table 9) 137

Recreational development (table 10) 145
Camp areas. Picnic areas. Playgrounds. Paths and trails. Golf fairways.

Wildlife habitat potentials (table 11) 151
Potential for habitat elements. Potential as habitat for—Openland wildlife, Woodland wildlife, Wetland wildlife.

Building site development (table 12) 155
Shallow excavations. Dwellings without basements. Dwellings with basements. Small commercial buildings. Local roads and streets. Lawns and landscaping.

Sanitary facilities (table 13) 161
Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.

Construction materials (table 14) 166
Roadfill. Sand. Gravel. Topsoil.

Water management (table 15) 171
Limitations for—Pond reservoir areas; Embankments, dikes, and levees; Aquifer-fed excavated ponds. Features affecting—Drainage, Irrigation, Terraces and diversions, Grassed waterways.

Engineering index properties (table 16) 177
Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve number—4, 10, 40, 200. Liquid limit. Plasticity index.

Physical and chemical properties of the soils (table 17) 183
Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Shrink-swell potential. Erosion factors. Wind erodibility group. Organic matter.

Soil and water features (table 18)..... 188
Hydrologic group. Flooding. High water table. Bedrock. Potential frost action. Risk of corrosion.

Classification of the soils (table 19)..... 192
Family or higher taxonomic class.

Preface

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

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

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

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

Soil Survey of
Monroe County, Iowa

By Douglas B. Oelmann, Soil Conservation Service

Fieldwork by Douglas B. Oelmann, Gary A. Lindgren, Jeff C. Talsky, and Jonathon A. Hempel, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with
the Iowa Agriculture and Home Economics Experiment Station;
the Cooperative Extension Service, Iowa State University;
and the Department of Soil Conservation, State of Iowa

General Nature of the County

MONROE COUNTY is in the south-central part of Iowa (fig. 1). It has an area of 278,400 acres, or 435 square miles. Albia, the county seat, is in the central part of the county. It is about 60 miles southeast of Des Moines.

Much of the acreage in the county is farmland, which is used mainly for corn, soybeans, oats, hay, and pasture. A small acreage is used as woodland. Corn and soybeans are the chief grain crops. Raising livestock, principally hogs and cow-calf herds, is an important enterprise.

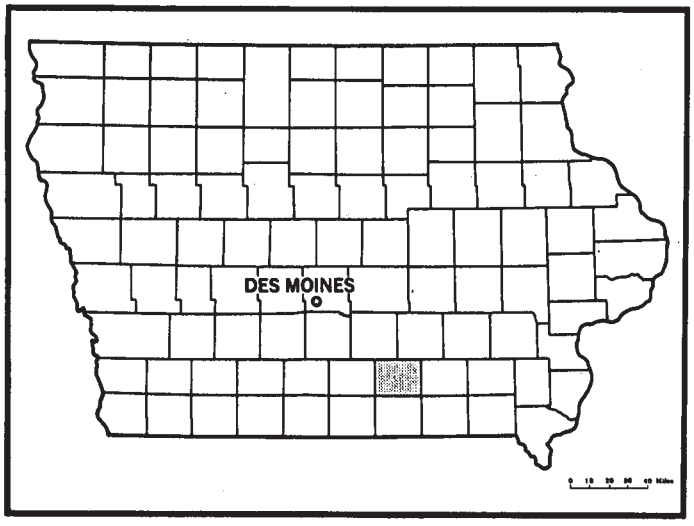


Figure 1.—Location of Monroe County in Iowa.

This survey updates the soil survey of Monroe County published in 1931 (*6*). It provides additional information and larger maps, which show the soils in greater detail.

History

The first inhabitants of the area now known as Monroe County were the Sac and Fox tribes of the Ioway Indians. Settlement of this area was made possible by the White Breast Treaty of 1840. In 1843, the first family of settlers arrived. They settled one-half mile southwest of Eddyville. In 1843, the county was established as Kish-Ko-Kosh County. It was named after a Sac and Fox Indian village chief. It was sponsored and administered by Wapello County (*4*).

In 1845, the county was organized as Monroe County. It was named after the fifth President of the United States. In 1846, the county seat was located at Princeton. Later, the name of this town was changed to Albia, meaning high plateau.

Prior to the Civil War, the prime industry in the county was agriculture. After the first railroad entered the county in the late 1860's, coal mining emerged as an important new industry. By 1900, the county was supplying Iowa's major railroads their operating coal. In 1910, there were 7 railroads and 39 mining camps and company towns in the county. The largest mining camp was Buxton, which at one time had a population of nearly 8,000. After the middle of the 1930's, coal mining activities declined steadily. Little or no trace of the mining camps remains. Only one shaft mine and two strip mines are currently in

operation. An estimated 20 percent of the coal under Monroe County has been mined.

The first census of the county was taken in 1850. It indicated a population of 2,884. The population increased by nearly 200 percent during the period 1850 to 1860. It was 9,209 in 1980. Since 1900, the urban population has been increasing an average of 5 percent every decade.

Physiography and Relief

Monroe County is part of what was once a broad plain (*3*). Most of the streams have cut the landscape to a considerable extent. Even the tributaries have cut headward into the divides. The cutting has given the county the broken appearance characteristic of south-central Iowa.

Remnants of the original plain make up a comparatively small part of the county. They occur as winding, nearly level upland divides ranging from 1/8 mile to 1 1/4 miles in width. The upper part of the break from the stable summits of the divides toward the streams is a gentle slope. At the lower elevations, however, the slopes generally are steeper.

One of the more notable divides bisects the county into almost equal east and west halves. This divide inclines gently to the north. It is at an elevation of 1,002 feet above sea level at Moravia, which is in the southern part of the county; 959 feet at Albia, in the center of the county; and 932 feet at Lovilia, in the northern part.

The vertical interval between the lowlands and the adjoining uplands ranges from 100 to 150 feet. The altitude of the uplands gradually increases towards the divides, which are at an elevation of more than 340 feet above the water level in the Des Moines River. The highest elevation in the county is 1,023 feet above sea level. It is in an area 4 miles north of the southwest corner of the county and along the boundary between Lucas and Monroe Counties. The lowest elevation is in the northeast corner, where the Des Moines River flows into Wapello County. It is about 660 feet above sea level at low flow.

Drainage

Through the Des Moines River drainage system, the Mississippi River eventually receives about 98 percent of the runoff in Monroe County. The runoff in a very small area in the southwestern part, however, drains toward the Chariton River and eventually into the Missouri River (*3*). Cedar Creek, which flows east and northwest, drains nearly all of the part of the county west of Albia. Whites, Coal, and Morman Creeks flow into Cedar Creek from the south. The runoff from the eastern half of the county flows into the Des Moines River, which flows across the northeast corner of the county. Bluff, Grays, and Miller Creeks flow northwest. Middle Avery and Soap Creeks are the major creeks flowing east and southeast.

Transportation Facilities

Three major highways serve Monroe County. U.S. Highway 34 traverses the county from east to west and State Highway 5 from north and south. These two highways intersect at Albia. State Highway 137 begins at Albia. It extends north for a few miles and then northeast to Eddyville. Hard-surface state highways or county roads connect the major highways to all of the smaller communities in the county. All farms are along farm-to-market roads of crushed limestone. The major county roads are well distributed throughout the county.

Other transportation facilities include four railroad lines, bus routes, an airport 2 miles southeast of Albia, and motor freight lines, which serve every trading center in the county.

Climate

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

The climate in Monroe County is subhumid and continental. Winters are cold, and summers are quite hot. Occasional cool spells occur in summer. The total annual precipitation normally is adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Albia in the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is about 26 degrees F, and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Albia on January 29, 1966, is -22 degrees. In summer the average temperature is about 74 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Albia on August 4, 1958, is 106 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 35.53 inches. Of this, nearly 25 inches, or about 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 19 inches. The heaviest 1-day rainfall during the period of record was 5.76 inches at Albia on August 7, 1977. Thunderstorms occur on about 50 days each year, and most occur in summer. Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration and result in sparse

damage in narrow belts. Hailstorms occur in scattered small areas at times during the warmer part of the year.

The average seasonal snowfall is about 33 inches. The greatest snow depth at any one time during the period of record was 33 inches. On an average of 30 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the

properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

General Soil Map Units

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

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

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

Soil Descriptions

1. Otley-Mahaska association

Nearly level to moderately sloping, moderately well drained and somewhat poorly drained, silty soils formed in loess; on uplands

This association consists of soils on broad flats and the upper side slopes. In most areas, the landscape is nearly level to gently rolling and slopes range from 0 to 9 percent.

This association makes up about 3 percent of the county. It is about 48 percent Otley soils, 27 percent Mahaska soils, and 25 percent soils of minor extent.

Otley soils are moderately well drained and are gently sloping and moderately sloping. They are on side slopes adjacent to the broad flats. Mahaska soils are somewhat poorly drained and are nearly level. They are on the broad flats.

Typically, the surface layer of the Otley soils is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 9 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is brown and yellowish brown and is mottled, the next part is mottled grayish brown, yellowish brown, and light brownish gray, and the lower part is light brownish gray and is mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Typically, the surface layer of the Mahaska soils is black and very dark gray silty clay loam about 7 inches thick. The subsurface layer is very dark gray silty clay loam about 12 inches thick. The subsoil is mottled, friable silty clay loam about 41 inches thick. The upper part is very dark grayish brown and dark grayish brown, the next part is grayish brown, and the lower part is olive gray.

Of minor extent in this association are Colo, Ely, Taintor, and Vanmeter soils. The poorly drained Colo and somewhat poorly drained Ely soils are along waterways. Their surface soil is thicker and darker than that of the major soils. The poorly drained Taintor soils are in slight depressions adjacent to the Mahaska soils on broad flats. The moderately well drained Vanmeter soils are downslope from the Otley and Mahaska soils. They formed in silty and loamy sediments and in the underlying residuum of calcareous shale.

Most of this association is used for cultivated crops. The main enterprises are growing cash crops and feeding livestock. Corn, soybeans, oats, and hay grow well on this association. Available water capacity is high. Organic matter content is moderate or high. The main management needs are measures that help to control erosion, improve drainage, and maintain fertility.

2. Ladoga-Gosport association

Gently sloping to steep, moderately well drained, silty soils formed in loess and residuum of acid shale; on stream benches and uplands

This association consists of soils on long, narrow ridgetops and dissected side slopes. In most areas, the landscape is undulating to very hilly and slopes range from 2 to 25 percent.

This association makes up about 6 percent of the county. It is about 42 percent Ladoga soils, 30 percent Gosport soils, and 28 percent soils of minor extent (fig. 2).

Ladoga soils are gently sloping and moderately sloping on long, convex ridgetops and are moderately sloping and strongly sloping on side slopes. They formed in loess. Gosport soils are strongly sloping to steep and are on side slopes. They formed in a silty mantle and in the underlying residuum of shale.

Typically, the surface layer of the Ladoga soils is very dark grayish brown and dark grayish brown silt loam

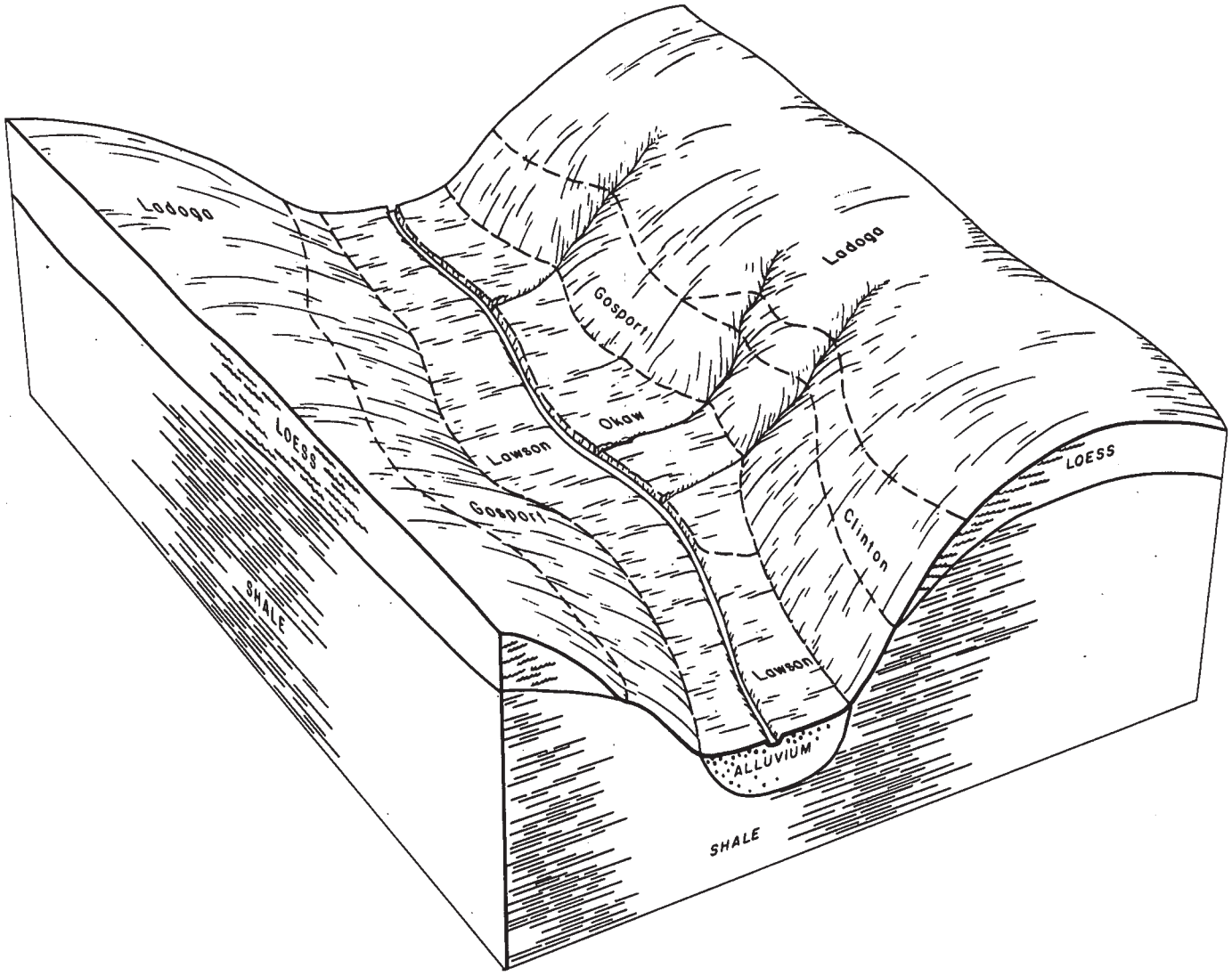


Figure 2.—Typical pattern of soils and parent material in the Ladoga-Gosport association.

about 7 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is friable silty clay loam about 40 inches thick. The upper part is brown, the next part is brown and yellowish brown and is mottled, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is brown silt loam.

Typically, the surface layer of the Gosport soils is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is dark grayish brown and brown and is very firm; the next part is brown, yellowish brown, and light olive brown, is mottled, and is extremely firm; and the lower part is light brownish gray, mottled, and extremely firm. Light brownish gray clay shale is at a depth of about 30 inches.

Of minor extent in this association are Colo, Clinton, Lawson, Nodaway, and Okaw soils and areas of Rock outcrop. Clinton soils are on convex ridgetops and the upper side slopes. Their surface layer is thinner and lighter colored than that of the Ladoga soils. Colo, Lawson, and Nodaway soils formed in alluvium on bottom land. Okaw soils are poorly drained and are on stream terraces. The areas of Rock outcrop are steep sandstone escarpments.

The gently sloping upland soils in this association generally are used for cultivated crops. The moderately

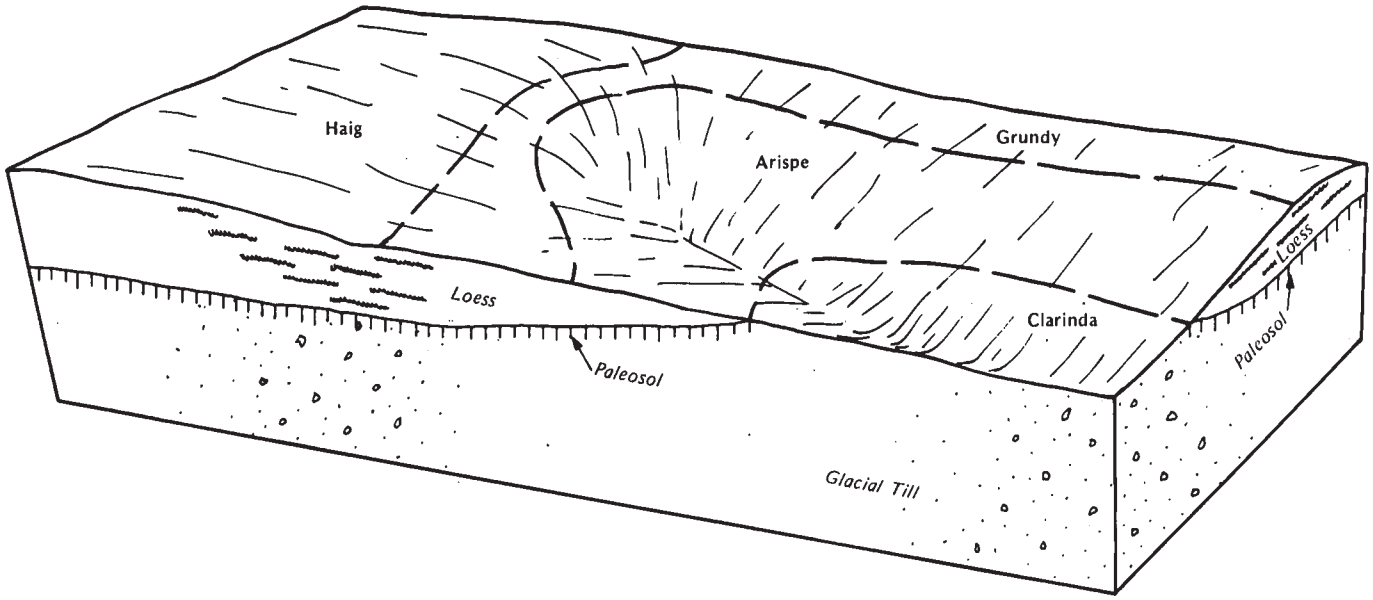


Figure 3.—Typical pattern of soils and parent material in the Arispe-Haig-Grundy association.

sloping and strongly sloping soils are used for cultivated crops and for hay and pasture. The steeper soils are used for permanent pasture, woodland, or wildlife habitat. Abandoned open-pit coal mines and spoil banks are in a few areas. The main enterprises are growing cash grain crops and raising cow-calf herds.

Corn, soybeans, oats, and hay grow moderately well on the gently sloping and moderately sloping soils in this association. Available water capacity is high or moderate. Organic matter content is moderate to low. The main management needs are measures that help to control erosion, help to prevent the formation of gullies, and maintain fertility.

3. Arispe-Haig-Grundy association

Nearly level to moderately sloping, moderately well drained to poorly drained, silty soils formed in loess; on uplands

This association consists of soils on broad flats and long and narrow, convex ridgetops and upper side slopes. In most areas, the landscape is nearly level to gently rolling and slopes range from 0 to 9 percent.

This association makes up about 13 percent of the county. It is about 27 percent Arispe soils, 26 percent Haig soils, 17 percent Grundy soils, and 30 percent soils of minor extent (fig. 3).

Arispe soils are moderately well drained or somewhat poorly drained and are moderately sloping. They are on short, convex side slopes. Haig soils are poorly drained and are nearly level. They are on broad divides. Grundy soils are somewhat poorly drained and are gently sloping. They are on the short, convex upper side slopes.

Typically, the surface layer of the Arispe soils is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown, firm silty clay, and the lower part is grayish brown and light brownish gray, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silt loam.

Typically, the surface layer of the Haig soils is black silty clay loam about 7 inches thick. The subsurface layer is black silty clay loam about 10 inches thick. The subsoil is about 43 inches thick. It is mottled. The upper part is very dark gray, firm silty clay; the next part is dark gray, firm silty clay grading with depth to olive gray, friable silty clay loam; and the lower part is light olive gray, friable silty clay loam.

Typically, the surface layer of the Grundy soils is black silty clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 3 inches thick. The subsoil is about 41 inches thick. It is mottled. The upper part is very dark grayish brown, firm silty clay loam; the next part is dark grayish brown and grayish brown, firm silty clay; and the lower part is grayish brown, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Of minor extent in this association are Clarinda, Edina, Lamoni, and Shelby soils. Clarinda soils are very slowly permeable and formed in a gray, clayey paleosol. They

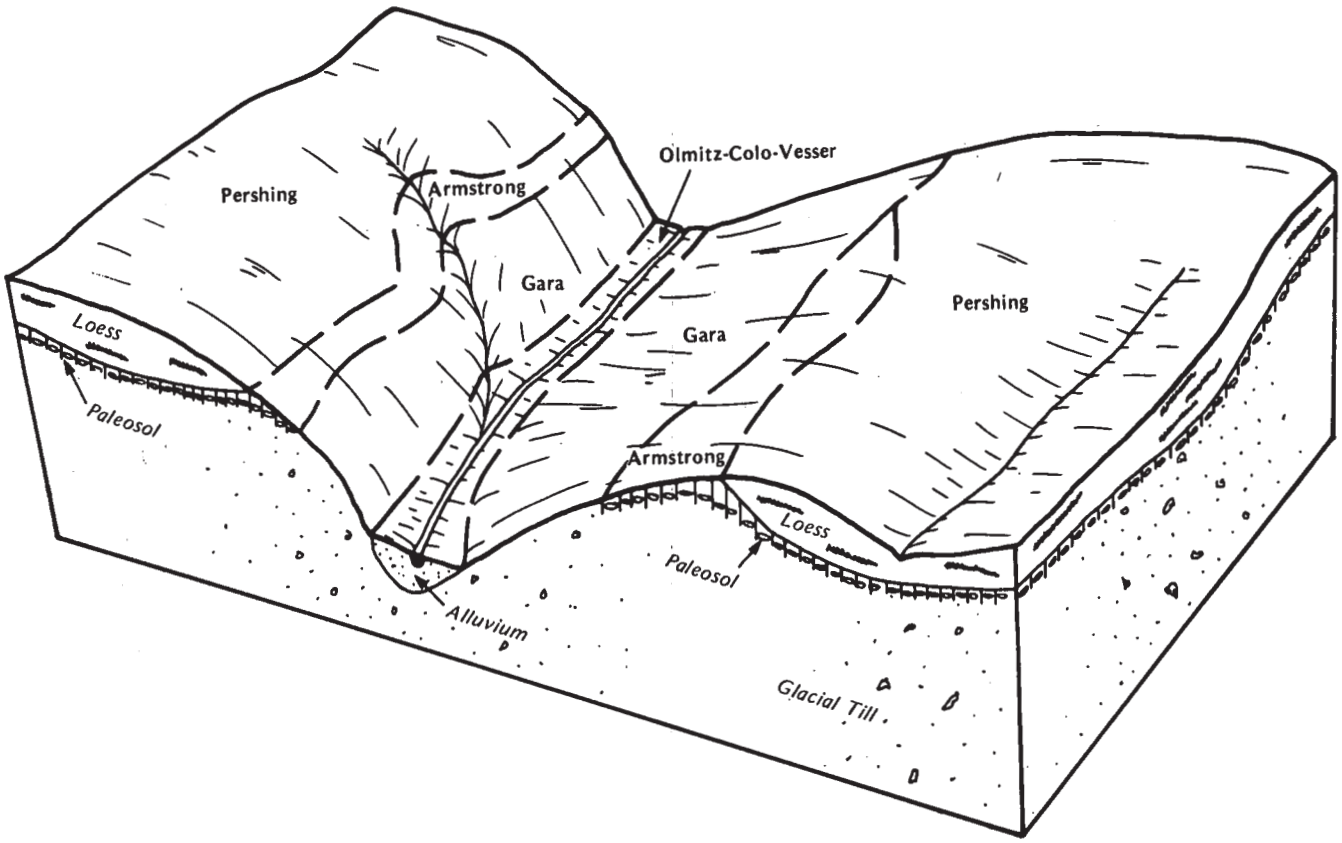


Figure 4.—Typical pattern of soils and parent material in the Pershing-Gara-Armstrong association.

are in upland coves. Edina soils are very slowly permeable and nearly level. They are on upland divides. Their subsurface layer is lighter colored than that of the adjacent Haig soils. Lamoni and Shelby soils formed in glacial till on side slopes. They are strongly sloping.

Most of this association is used for row crops, small grain, and hay. The main enterprises are growing cash crops and feeding livestock. Corn, soybeans, oats, and hay grow well on this association. Available water capacity is high. Organic matter content is high or moderate. The main management needs are measures that help to control erosion, improve drainage, and maintain fertility. The moderately sloping soils are subject to erosion. A subsurface drainage system is needed in the nearly level areas.

4. Pershing-Gara-Armstrong association

Gently sloping to steep, well drained to somewhat poorly drained, silty and loamy soils formed in loess and glacial till; on uplands

This association consists of soils on long and narrow, convex ridgetops and dissected side slopes. In most areas, the landscape is undulating to steep and slopes range from 2 to 25 percent.

This association makes up about 39 percent of the county. It is about 44 percent Pershing soils, 33 percent Gara soils, 15 percent Armstrong soils, and 8 percent soils of minor extent (fig. 4).

Pershing soils are moderately well drained or somewhat poorly drained and are gently sloping to strongly sloping. They formed in loess on convex ridgetops and the upper side slopes. Gara soils are moderately well drained or well drained and are strongly sloping to steep. They formed in glacial till on convex side slopes. Armstrong soils are moderately well drained or somewhat poorly drained and are moderately sloping and strongly sloping. They are on narrow, convex ridgetops and the upper side slopes. They formed in loess and in the underlying paleosol weathered from glacial till.

Typically, the surface layer of the Pershing soils is very dark grayish brown silty clay loam about 6 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 45 inches thick. The upper part is brown, friable silty clay loam that has dark grayish brown mottles; the next part is dark grayish brown and grayish brown, firm silty clay and silty clay loam; and the lower part is light grayish brown, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silty clay loam.

Typically, the surface layer of the Gara soils is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 39 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and has strong brown and grayish brown mottles. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Typically, the surface layer of the Armstrong soils is very dark grayish brown loam about 5 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 46 inches thick. The upper part is brown, the next part is brown and has yellowish red mottles, and the lower part is strong brown. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown clay loam.

Of minor extent in this association are Belinda, Bucknell, Colo, Lawson, Olmitz, Rinda, and Vesser soils. Belinda soils are poorly drained, very slowly permeable, and nearly level. They are on upland divides. Bucknell and Rinda soils formed in a gray, clayey paleosol weathered from glacial till. They are in upland coves and on side slopes upslope from the Gara and Armstrong soils. Colo, Lawson, and Vesser soils formed in silty alluvium on bottom land. Their surface soil is thick and dark. Also, Colo and Vesser soils are poorly drained. Olmitz soils formed in loamy alluvium on foot slopes. Their surface soil is thick and dark.

The gently sloping to moderately sloping upland soils in this association generally are used for cultivated crops. The strongly sloping to steep soils generally are used for permanent pasture, woodland, and wildlife habitat. Many ponds are in the steep areas. They help to control erosion and provide water for livestock. The bottom land is used for cultivated crops, hay, permanent pasture, or woodland, depending on the width of the area and the extent to which the stream channel meanders. The main enterprises are growing cash grain crops and raising cow-calf herds.

Corn, soybeans, oats, and hay grow moderately well on the gently sloping and moderately sloping soils in this association. Available water capacity is high or moderate. Organic matter content is moderately low or moderate. The main management needs are measures that help to control erosion, prevent the formation of gullies, and maintain fertility.

5. Weller-Lindley-Keswick association

Gently sloping to very steep, moderately well drained and well drained, silty and loamy soils formed in loess and glacial till; on uplands

This association consists of soils on long and narrow, convex ridgetops and dissected side slopes. In most areas, the landscape is undulating to very steep and slopes range from 2 to 40 percent.

This association makes up about 19 percent of the county. It is about 54 percent Weller soils, 22 percent Lindley soils, 12 percent Keswick soils, and 12 percent soils of minor extent (fig. 5).

Weller soils are moderately well drained and are gently sloping to strongly sloping. They formed in loess on convex ridgetops and the upper side slopes. Lindley soils are well drained and are strongly sloping to very steep. They formed in glacial till on convex side slopes. Keswick soils are moderately well drained and are moderately sloping and strongly sloping. They are on narrow, convex ridgetops and convex side slopes. They formed in a paleosol weathered from glacial till.

Typically, the surface layer of the Weller soils is dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is brown and yellowish brown, friable and firm silty clay loam and silty clay, and the lower part is grayish brown and brownish gray, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silty clay loam.

Typically, the surface layer of the Lindley soils is very dark grayish brown loam about 4 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is firm clay loam about 41 inches thick. The upper part is yellowish brown, and the lower part is dark yellowish brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown and light brownish gray clay loam.

Typically, the surface layer of the Keswick soils is dark grayish brown loam about 5 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is yellowish red and brown, firm clay loam and clay; the next part is brown and yellowish brown, mottled, firm clay; and the lower part is strong brown, mottled, firm clay loam.

Of minor extent in this association are Ashgrove, Beckwith, Colo, Douds, Galland, Olmitz, and Vesser soils. Ashgrove soils are very slowly permeable. They formed in a gray, clayey paleosol in upland coves. Beckwith soils are very slowly permeable and nearly level. They formed in loess on upland divides. The poorly drained Colo and Vesser soils formed in silty alluvium on

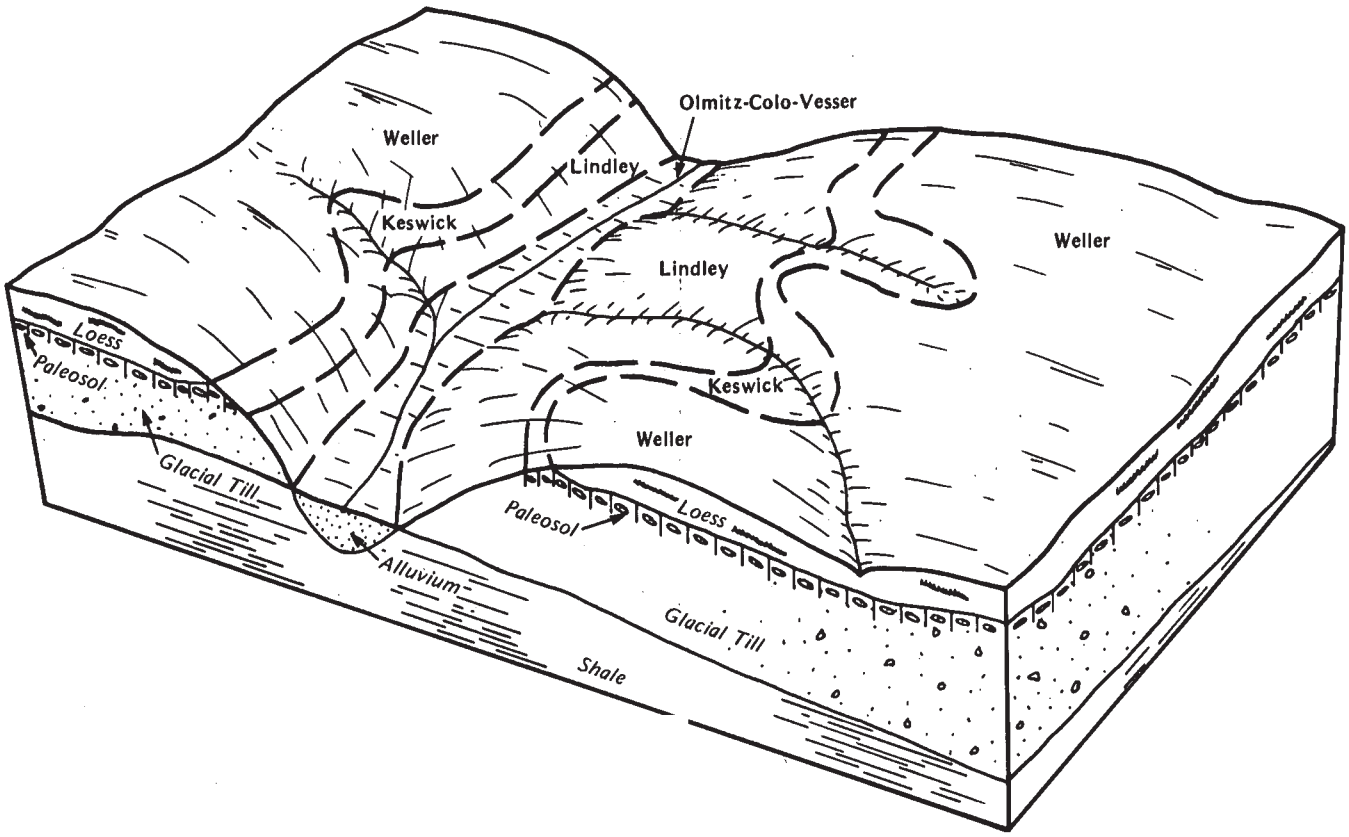


Figure 5.—Typical pattern of soils and parent material in the Weller-Lindley-Keswick association.

bottom land. Douds and Galland soils formed in alluvium on high terraces adjacent to the major streams. Olmitz soils formed in loamy local alluvium on foot slopes and alluvial fans. Their surface soil is thick and dark.

The gently sloping and moderately sloping soils in this association generally are used for hay and permanent pasture. The strongly sloping to very steep soils generally are used for permanent pasture, woodland, or wildlife habitat. They are too steep for cultivation. Most of the wooded areas in the county are in this association. Many ponds are in the deep, gullied upland drainageways. They provide water for livestock. The main enterprises are raising cow-calf herds and logging.

Corn, soybeans, oats, and hay grow moderately well on the gently sloping and moderately sloping soils in this association. Available water capacity is moderate or high. Organic matter content is moderately low or low. The main management needs are measures that help to control erosion, prevent the formation of gullies, and maintain fertility. The steep slopes restrict the use of logging equipment. In clearcut areas erosion is a severe hazard unless a protective plant cover is established.

6. Pershing-Gosport-Lindley association

Gently sloping to very steep, well drained to somewhat poorly drained, silty and loamy soils formed in loess, glacial till, and residuum of acid shale; on uplands

This association consists of soils on long and narrow, convex ridgetops and dissected side slopes. In most areas, the landscape is undulating to very steep and slopes range from 2 to 40 percent.

This association makes up about 14 percent of the county. It is about 34 percent Pershing soils, 28 percent Gosport soils, 10 percent Lindley soils, and 28 percent soils of minor extent (fig. 6).

Pershing soils are moderately well drained or somewhat poorly drained and are gently sloping to strongly sloping. They formed in loess on convex ridgetops and the upper side slopes. Gosport soils are moderately well drained and are strongly sloping to steep. They are on the lower side slopes. They formed in

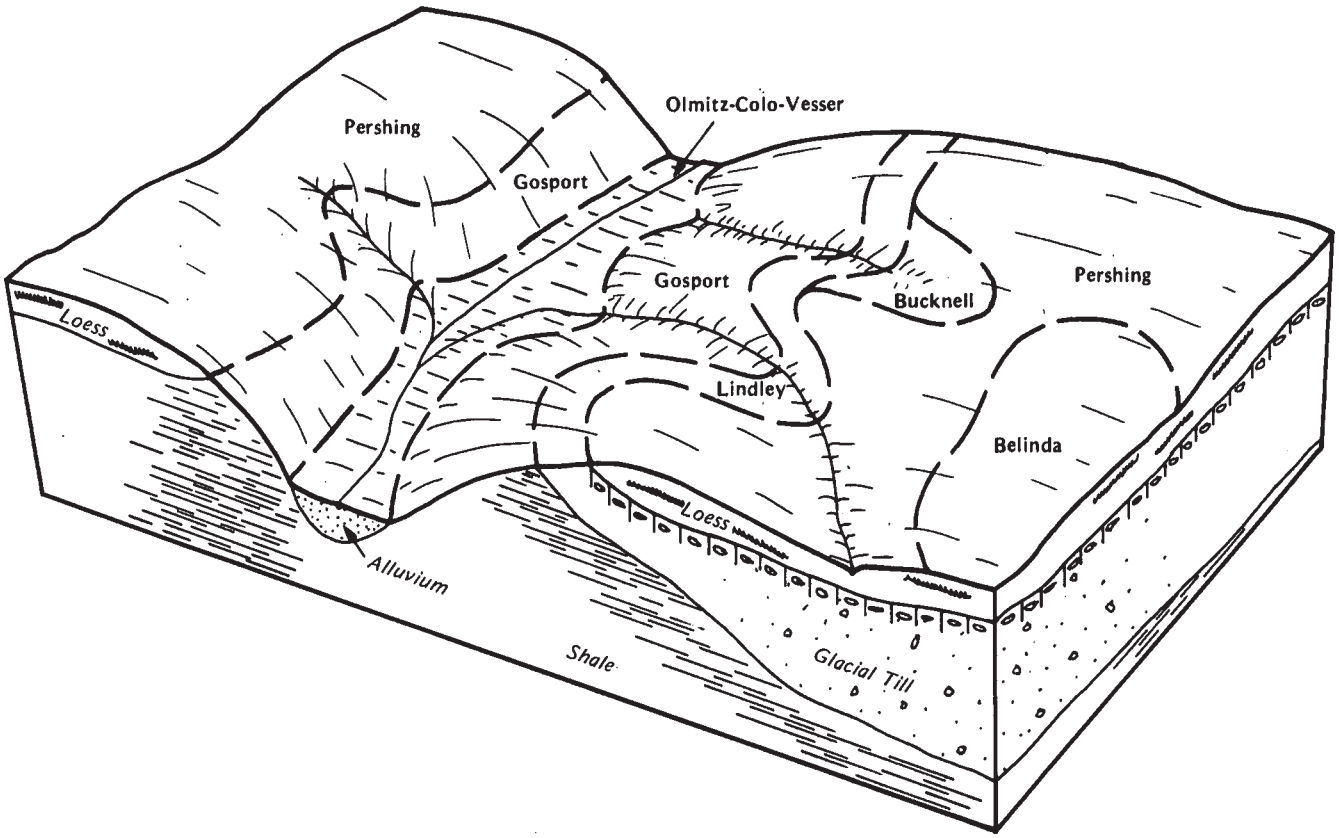


Figure 6.—Typical pattern of soils and parent material in the Pershing-Gosport-Lindley association.

a silty mantle and in the underlying residuum of shale. Lindley soils are well drained and are strongly sloping to very steep. They formed in glacial till on convex side slopes.

Typically, the surface layer of the Pershing soils is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is silty clay loam about 44 inches thick. The upper part is brown and grayish brown, is mottled, and is firm, and the lower part is grayish brown and friable. The substratum to a depth of about 60 inches is grayish brown silty clay loam.

Typically, the surface layer of the Gosport soils is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is dark grayish brown and brown and is very firm; the next part is brown, yellowish brown, and light olive brown, is mottled, and is extremely firm; and the lower part is light brownish gray, mottled, and extremely firm. Light brownish gray clay shale is at a depth of about 30 inches.

Typically, the surface layer of the Lindley soils is very dark grayish brown loam about 4 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is firm clay loam about 41 inches thick. The upper part is yellowish brown, and the lower part is dark yellowish brown and yellowish brown and is mottled. The substratum to a depth of about 60 inches is mottled yellowish brown and light brownish gray clay loam.

Of minor extent in this association are Armstrong, Belinda, Bucknell, Colo, Olmitz, Rinda, and Vesser soils. Armstrong, Bucknell, and Rinda soils formed in a paleosol and are slowly or very slowly permeable. They are downslope from the Pershing soils and upslope from the Lindley soils. Belinda soils are poorly drained and nearly level. They formed in loess on upland divides. Colo and Vesser soils are poorly drained. They formed in alluvium on bottom land. Olmitz soils are on foot slopes and alluvial fans. Their surface soil is thick and dark.

The gently sloping and moderately sloping upland soils in this association are used for cultivated crops. Some of the strongly sloping and moderately steep areas are used for row crops, small grain, or hay. The rest of the moderately steep soils and the steep and very steep soils are used for permanent pasture, woodland, or wildlife habitat. Many ponds are in the steep areas. They help to control erosion and provide water for livestock. The bottom land is used for cultivated crops, hay, permanent pasture, or woodland, depending on the width of the area and the extent to which the stream channel meanders. The main enterprises are growing cash grain crops and raising cow-calf herds.

Corn, soybeans, oats, and hay grow moderately well on the gently sloping and moderately sloping soils in this association. Available water capacity is moderate or high. Organic matter content is low to moderate. The main management needs are measures that help to control erosion, prevent the formation of gullies, and maintain fertility.

7. Lawson-Nodaway-Colo association

Nearly level and gently sloping, moderately well drained to poorly drained, silty soils formed in alluvium; on bottom land

This association consists of soils on flood plains and alluvial fans along the major streams. These soils are subject to flooding. Slopes range from 0 to 5 percent.

This association makes up about 6 percent of the county. It is about 35 percent Lawson soils, 23 percent Nodaway soils, 10 percent Colo soils, and 32 percent soils of minor extent.

Nodaway and Lawson soils are nearly level and commonly are adjacent to the stream channels. Lawson soils are somewhat poorly drained and Nodaway soils moderately well drained. Colo soils are poorly drained and are nearly level and gently sloping. They are adjacent to the uplands.

Typically, the surface layer of the Lawson soils is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 26 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown silty clay loam and silt loam. It is mottled in the lower part.

Typically, the surface layer of the Nodaway soils is very dark grayish brown silt loam about 7 inches thick. The substratum to a depth of about 60 inches is stratified very dark grayish brown, dark grayish brown, and grayish brown silt loam.

Typically, the surface layer of the Colo soils is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 29 inches thick. The substratum to a depth of about 60 inches is very dark gray and dark gray, mottled silty clay loam.

Of minor extent in this association are Okaw, Vesser, and Zook soils. Okaw soils are very slowly permeable. They formed in alluvium on low terraces. The landscape positions of Vesser and Zook soils are similar to those of the Colo soils. Vesser soils are grayer than the major soils, and Zook soils contain more clay and are slowly permeable.

Most of this association is used for cultivated crops, small grain, and hay. Areas characterized by meandering stream channels and narrow stream valleys are used for pasture or habitat for woodland wildlife. The main enterprise is growing cash grain crops.

The soils in this association generally are well suited to cultivated crops if they are adequately drained and protected from flooding. Corn, soybeans, oats, hay, and pasture plants grow well. Available water capacity is high. Organic matter content is moderately low to high. The main management needs are measures that improve drainage, protect the soils from floodwater, and maintain fertility. The soils can be drained by tile and surface drains if adequate outlets are available. Diversions, levees, and channel improvements help to control floodwater and the runoff from adjacent areas.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pershing silt loam, 2 to 5 percent slopes, is one of several phases in the Pershing series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Olmitz-Colo-Vesser complex, 2 to 5 percent slopes, is an example.

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

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

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

Soil Descriptions

11B—Colo-Ely silty clay loams, 2 to 5 percent slopes. These gently sloping soils are along small streams and narrow upland drainageways. The poorly drained Colo soil is nearer the stream channels or waterways than the somewhat poorly drained Ely soil and is subject to flooding. It is bordered by bands of the Ely soil. The Colo soil is in irregularly shaped areas that range from 10 to 150 acres in size. The Ely soil is in long and narrow areas that range from 10 to more than 30 acres in size. Individual areas of the map unit are about 65 percent Colo soil and 35 percent Ely soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Colo soil is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 29 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is very dark gray and dark gray, mottled silty clay loam. In some areas the soil contains more clay.

Typically, the surface layer of the Ely soil is black silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown and very dark gray silty clay loam about 19 inches thick. The subsoil to a depth of about 60 inches is grayish brown, mottled, friable silty clay loam.

These soils are moderately permeable. They have a seasonal high water table. Surface runoff is medium or slow. Available water capacity is high. The content of organic matter typically is 4 to 7 percent in the surface layer. Reaction typically is neutral throughout the profile.

The subsoil of the Ely soil and the subsurface layer of the Colo soil have a very low supply of available potassium. The subsurface layer of the Colo soil has a medium supply of available phosphorus and the subsoil of the Ely soil a low supply.

Most areas are cultivated. These soils are moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soils are drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soils from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

13B—Olmitz-Colo-Vesser complex, 2 to 5 percent slopes. These gently sloping soils are in narrow drainageways and on narrow foot slopes. The moderately well drained Olmitz and somewhat poorly drained or poorly drained Vesser soils are on the upper parts of the slopes. The poorly drained Colo soil is on the lower parts, nearer the stream channels. The Colo and Vesser soils are subject to flooding. Areas are long and narrow and range from 10 to more than 30 acres in size. They are about 40 percent Olmitz soil, 30 percent Colo soil, and 20 percent Vesser soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Olmitz soil is very dark brown loam about 8 inches thick. The subsurface layer is loam about 21 inches thick. The upper part is black, the next part is very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of about 60 inches is friable clay loam. The upper part is very dark grayish brown, and the lower part is dark brown.

Typically, the surface layer of the Colo soil is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 29 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is very dark gray and dark gray, mottled silty clay loam.

Typically, the surface layer of the Vesser soil is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark gray silt loam about 29 inches thick. The subsoil to a depth of about 60 inches is dark gray, mottled, friable silty clay loam.

Included with these soils in mapping are small areas of Nodaway and Zook soils. The moderately well drained, stratified Nodaway soils are near the stream channels. The poorly drained Zook soils are on the lowest parts of the slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Olmitz, Colo, and Vesser soils. The Colo and Vesser soils have a seasonal high water table. Surface runoff is slow or medium on all three soils. Available water capacity is high. The content of organic matter in the surface layer of the Olmitz and Vesser soils is about 3 to 4 percent, and that in the surface layer of the Colo soil is about 5 to 7 percent. The surface layer of all three soils generally is medium acid to neutral. The supply of available phosphorus is medium in the subsoil of the Vesser soil and the subsurface layer of the Colo soil and very low in the subsoil of the Olmitz soil. The supply of available potassium is very low in the subsoil of the Olmitz soil and the subsurface layer of the Colo soil and low in the subsoil of the Vesser soil.

Most areas are cultivated. These soils are moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soils are drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soils from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. Interseeding the grasses and legumes into the existing sod eliminates the need for plowing when a seedbed is prepared.

The land capability classification is IIw.

23C—Arispe silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained or somewhat poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 40 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 10 inches thick. The subsoil is mottled silty clay loam about 36 inches thick. The upper part is very dark grayish brown and friable, the next part is dark grayish brown and firm, and the lower part is grayish brown and light brownish gray and is very firm and firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam.

Included with this soil in mapping are small areas of the poorly drained Clarinda soils on the lower parts of the side slopes above the drainageways. These soils make up 5 to 10 percent of the unit.

The Arispe soil is moderately slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer is neutral. The subsoil commonly is medium acid or slightly acid. It typically has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Permanent pastures can be improved by renovating and reseeding. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

23C2—Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained or somewhat poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 20 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 32 inches thick. It is mottled. The upper part is dark grayish brown, firm silty clay, and the lower part is grayish brown and light brownish gray, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam.

Included with this soil in mapping are small areas of the poorly drained Clarinda soils on the lower parts of the side slopes above the drainageways. These soils make up 5 to 10 percent of the unit.

The Arispe soil is moderately slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter generally is 2.5 to 3.0 in the surface layer. Unless the soil has been limed, the surface layer and subsoil typically are medium acid. The subsoil typically has a very low supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

24D2—Shelby clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or well drained soil is on convex side slopes and on the narrow tops of some low ridges. Areas are long and narrow and generally are parallel to intermittent streams. They range from 5 to 15 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown subsoil material. The subsoil is firm clay loam about 32 inches thick. It is dark yellowish brown in the upper part and yellowish brown in the lower part. The substratum to a depth of about 60 inches is dark yellowish brown clay loam.

Included with this soil in mapping are small areas of Adair and Lamoni soils. These soils contain more clay in the subsoil than the Shelby soil. Also, they are higher on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer is slightly acid unless it is limed. The subsoil has a low supply of available phosphorus and a high supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

24E2—Shelby clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on irregular, convex slopes that are dissected by gullies and waterways. Areas are long and narrow and generally are parallel to intermittent streams. They are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is firm clay loam about 31 inches thick. It is brown in the upper part and yellowish brown in the lower part. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Included in this soil in mapping are small areas of Adair and Lamoni soils. These soils contain more clay in the subsoil than the Shelby soil. Also, they are higher on the landscape. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Shelby soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer is medium acid or slightly acid unless it is limed. The subsoil has a low supply of available phosphorus and a high supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

41D—Sparta loamy fine sand, 5 to 14 percent slopes. This moderately sloping and strongly sloping, excessively drained soil is on uplands and stream terraces. Areas are irregular in shape and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is dark brown loamy fine sand about 8 inches thick. The subsoil is dark yellowish brown, very friable loamy fine sand about 19 inches thick. The substratum to a depth of about 60 inches is yellowish brown fine sand.

Permeability is rapid. Surface runoff is slow or medium. Available water capacity is low. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is neutral. The subsoil commonly is medium acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture and hay. This soil is poorly suited to corn, soybeans, and small grain and is moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. Also, droughtiness is a limitation. A conservation tillage system that leaves crop residue on the surface and contour farming conserve moisture and help to control erosion. If the soil is plowed in the fall, soil blowing is a hazard. It can be controlled, however, by leaving a roughened surface, by alternating tilled and untilled strips, and by chisel plowing, which leaves crop residue on the surface. Chisel plowing also conserves moisture. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth.

A cover of hay or pasture plants is effective in controlling erosion. Managing this droughty soil for pasture is difficult. Permanent pastures can be improved by renovating and reseeding. Proper stocking rates, pasture rotation, timely deferment of grazing, especially during dry periods, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees. It generally supports trees only in groves and around farmsteads. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other hazards or limitations affect planting or harvesting.

The land capability classification is VIs.

51—Vesser silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained or poorly drained soil is in the higher areas on bottom land and on foot slopes and alluvial fans. It is subject to flooding. Areas are irregular in shape and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is very dark grayish brown, dark gray, and very dark gray silt loam about 24 inches thick. It is mottled in the lower part. The subsoil to a depth of about 60 inches is dark gray and dark grayish brown, mottled, friable and firm

silty clay loam. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Colo soils on the lower slopes. These soils cannot be drained so easily as the Vesser soil. They make up 5 to 10 percent of the unit.

The Vesser soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The content of organic matter typically is 3 to 4 percent in the surface layer. This layer typically is neutral if it is limed. The subsoil commonly is slightly acid. It generally has a medium supply of available phosphorus and a low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

54—Zook silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Areas are irregular in shape and commonly range from 5 to more than 40 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is about 26 inches of black and very dark gray silty clay loam and silty clay. The subsoil is very dark gray, mottled, firm silty clay about 12 inches thick. The substratum to a depth of about 60 inches is very dark gray silty clay. In some small areas the surface layer is very dark grayish brown silt loam overwash as much as 10 inches thick.

Included with this soil in mapping are scattered small areas of Colo soils. These soils can be drained more easily than the Zook soil. They make up 5 to 10 percent of the unit.

The Zook soil is slowly permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 5 to 7 percent in the surface layer. The surface layer and subsoil commonly are neutral. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

54+—Zook silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on first bottoms along the major streams. It is subject to flooding. Areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown and very dark grayish brown silt loam about 18 inches thick. The subsoil to a depth of about 60 inches is black, mottled silty clay loam and silty clay.

This soil is slowly permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The content of organic matter typically is 1 to 3 percent in the surface layer. This layer is slightly acid to mildly alkaline. The subsoil has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

58D2—Douds loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately

well drained soil is on high stream terraces along the major streams and rivers. Areas are irregular in shape and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. It is mixed with some streaks and pockets of dark yellowish brown subsoil material. The subsoil extends to a depth of 60 inches or more. The upper part is dark yellowish brown, yellowish brown, and brownish yellow, friable loam. The next part is yellowish brown and brownish yellow, friable sandy clay loam. The lower part is dark yellowish brown, yellowish brown, and light brownish gray, firm clay loam. It is mottled below a depth of 50 inches.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The content of organic matter typically is 0.5 to 1.0 percent in the surface layer. The surface layer and subsoil typically are strongly acid unless the soil is limed. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. No limitations or hazards affect planting or harvesting if the proper species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

58E2—Douds loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on high stream terraces along the major streams and rivers. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is about 44 inches thick. It is friable. The upper part is brown clay loam, the next part is dark yellowish brown and strong brown clay loam, and the lower part is strong brown and yellowish brown sandy clay loam. The substratum to a depth of about 60 inches is grayish brown and brown, mottled clay loam.

Included with this soil in mapping are small areas of Gosport soils on the higher parts of the landscape. These soils are moderately deep over clay shale. They make up 5 to 15 percent of the unit.

The Douds soil is moderately permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The content of organic matter typically is 0.5 to 1.0 percent in the surface layer. The surface layer and subsoil commonly are strongly acid unless the soil is limed. The subsoil generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Further erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

65D—Lindley loam, 9 to 14 percent slopes. This strongly sloping, well drained soil is on convex, narrow ridgetops, nose slopes, and side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown loam about 3 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 45 inches thick. The upper part is brown, friable loam, and the lower part is yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of the side slopes. These soils are moderately deep over clay shale. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter typically is 1.0 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. This soil is poorly suited to intensive row cropping. It is moderately well suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. No limitations or hazards affect planting or harvesting if the proper species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

65E—Lindley loam, 14 to 18 percent slopes. This moderately steep, well drained soil is on convex, narrow ridgetops, nose slopes, and side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark gray loam about 2 inches thick. The subsurface layer is dark grayish brown loam about 6 inches thick. The subsoil is about 44 inches thick. The upper part is brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of the side slopes. These soils are moderately deep over clay shale. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter typically is 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid. The subsoil commonly is very strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

65E2—Lindley loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained soil is on convex, narrow ridgetops, nose slopes, and side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown loam about 4 inches thick. It is mixed with some streaks and pockets of yellowish brown subsoil material. The subsoil is yellowish brown, firm clay loam about 35 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of the slopes. These soils are moderately deep over clay shale. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter typically is less than 0.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a low supply of

available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Further erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

65G—Lindley loam, 18 to 40 percent slopes. This steep and very steep, well drained soil is on valley side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 4 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay loam about 41 inches thick. The substratum to a depth of about 60 inches is mottled yellowish brown and light brownish gray clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of the side slopes. These soils are moderately deep over clay shale. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is 0.5 to 1.0 percent in the surface layer. The surface layer and subsoil commonly are very strongly acid unless the soil is limed. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture, woodland, or wildlife habitat. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

Most areas support native hardwoods. This soil is suited to trees. Erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. This equipment cannot be used in the steeper areas. Special equipment can be used in areas where the slope is less than 35 percent. Caution in operating this equipment is needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from areas where trees and shrubs are planted and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

76B—Ladoga silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. It is adjacent to narrow and moderately broad flats. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is friable silty clay loam about 43 inches thick. The upper part is brown, the next part is brown and mottled, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of wetter soils on the less sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Figure 7.—Soybeans planted on the contour in an area of Ladoga silt loam, 2 to 5 percent slopes.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion and soil blowing are moderate hazards. They can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming (fig. 7), grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in some areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a moderate hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIe.

76C—Ladoga silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 40 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is friable and firm silty clay loam about 42 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is brown and mottled. The substratum to a depth of about 60 inches is brown, mottled silt loam.

Permeability is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer is very friable and can be easily tilled. It typically is neutral. The subsoil commonly is medium acid or slightly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

76C2—Ladoga silt loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on the edge of convex, narrow upland divides and on upland side slopes. Areas typically are long and narrow or irregularly shaped and range from 20 to 80 acres in size.

Typically, the surface layer is very dark grayish brown and dark grayish brown silt loam about 7 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is friable silty clay loam about 40 inches thick. It is brown in the upper part, brown and yellowish brown and mottled in the next part, and grayish brown and mottled in the lower part. The substratum to a depth of about 60 inches is brown silt loam.

Permeability is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. The surface layer and subsoil typically are medium acid unless the soil is limed. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

76D—Ladoga silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on the upper side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 4 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is friable silty clay loam about 40 inches thick. The upper part is brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam.

Included with this soil in mapping are small areas of somewhat poorly drained soils at the head of drainageways. These soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 1 to 2 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of

conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

76D2—Ladoga silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex upland slopes. Areas generally are somewhat long and narrow or are irregularly shaped. They range from 15 to 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. It is mixed with some streaks and pockets of brown silty clay loam subsoil material. The subsoil is friable silty clay loam about 38 inches thick. It is dark grayish brown and brown in the upper part, brown and yellowish brown and mottled in the next part, and mottled light brownish gray and yellowish brown in the lower part. The substratum to a depth of about 60 inches is mottled light brownish gray and yellowish brown silt loam.

Included with this soil in mapping are small areas of somewhat poorly drained soils at the head of drainageways. These soils make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. The surface layer and subsoil typically are medium acid unless the soil is limed. The subsoil generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

80D—Clinton silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on the upper side slopes and convex ridgetops in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 10 inches thick. The subsoil is about 33 inches of yellowish brown, friable and firm silty clay loam and silty clay. It is mottled in the lower part. The substratum to a depth of about 60 inches is yellowish brown, mottled silty clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of the side slopes. These soils are moderately deep over clay shale and are very slowly permeable. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Clinton soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid. The subsoil is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result,

the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

80D2—Clinton silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on the upper side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 4 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is firm silty clay loam about 31 inches thick. The upper part is brown, and the lower part is grayish brown and mottled. The substratum to a depth of about 60 inches is grayish brown and light grayish brown, mottled silty clay loam.

Permeability is moderately slow. Surface runoff is rapid. Available water capacity is high. The content of organic matter is less than 0.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

130—Belinda silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on narrow or moderately broad upland divides. Areas are irregular in shape and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is silt loam about 12 inches thick. It is dark gray in the upper part and grayish brown and light brownish gray in the lower part. The subsoil extends to a depth of about 60 inches or more. The upper part is dark grayish brown, firm silty clay loam; the next part is dark grayish brown and grayish brown, mottled, firm and very firm silty clay; and the lower part is mottled yellowish brown and olive gray, firm silty clay loam.

Included with this soil in mapping are small areas of Pershing soils on the more sloping parts of the landscape. These soils are better drained than the Belinda soil. They make up 5 to 10 percent of the unit.

The Belinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is very slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer is medium acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A subsurface drainage system is needed because the wetness and a low soil temperature delay spring planting. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, also helps to overcome the wetness and low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

A few areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Erosion is not a serious hazard when the trees are logged or when logging roads are constructed.

The land capability classification is IIIw.

131B—Pershing silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained or

somewhat poorly drained soil is on convex ridgetops and side slopes bordering nearly level, stable interstream divides in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 6 inches thick. The subsurface layer is dark grayish brown, mottled silt loam about 3 inches thick. The subsoil extends to a depth of more than 60 inches. The upper part is mottled grayish brown and yellowish brown, friable, firm, and very firm silty clay loam and silty clay, and the lower part is mottled yellowish brown, gray, and grayish brown, friable silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Belinda soils on the less sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

The Pershing soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 2 to 3 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. It generally supports trees only in groves and around farmsteads. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

131C—Pershing silt loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained or moderately well drained soil is on convex ridgetops and short, convex side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 60 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is silty clay loam about 44 inches thick. The upper part is brown and grayish brown, is mottled, and is firm, and the lower part is grayish brown and friable. The substratum to a depth of about 60 inches is grayish brown silt clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the lower parts of the side slopes. These soils contain more clay in the subsoil than the Pershing soil and can be seepy during wet periods. They make up 5 to 10 percent of the unit.

The Pershing soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 2.0 to 2.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. It generally supports trees only in groves and around farmsteads. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

132B—Weller silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 11 inches thick. The subsoil extends to a depth of about 60 inches or more. The upper part is yellowish brown, friable and firm silty clay loam; the next part is yellowish brown, mottled, firm silty clay; and the lower part is mottled grayish brown, olive gray, yellowish brown, and strong brown, firm silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Beckwith soils on the less sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

The Weller soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is very strongly acid or strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. It generally supports trees only in groves and around farmsteads. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

132C—Weller silt loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and short, convex side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 3 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is brown and yellowish brown, friable and firm silty clay loam and silty clay, and the lower part is grayish brown and brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of Ashgrove and Keswick soils on the lower parts of the side slopes. These soils contain more clay in the subsoil than the Weller soil and can be seepy during wet periods. They make up 5 to 10 percent of the unit.

The Weller soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. It generally supports trees only in groves and around farmsteads. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

133—Colo silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Areas typically are long and narrow or irregularly shaped. They commonly range from 10 to more than 40 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 29 inches thick. The substratum to a depth of about 60 inches is very dark gray and dark gray, mottled silty clay loam. In some areas the subsurface layer contains more clay.

Figure 8.—Installing drainage tile in an area of Colo silty clay loam, 0 to 2 percent slopes.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 5 to 7 percent in the surface layer. This layer typically is slightly acid unless it is limed. The lower part of the subsurface layer generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed (fig. 8). In many areas diversion

terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

133B—Colo silty clay loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is at the base of valley slopes and in some drainageways. Areas are long and narrow and range from 5 to more than 30 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 28 inches thick. It is mottled in the lower part. The substratum to a depth of about 60 inches is very dark gray, mottled silty clay loam.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 5 to 7 percent in the surface layer. This layer typically is slightly acid unless it is limed. The lower part of the subsurface layer has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

133+—Colo silt loam, overwash, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom land. It is subject to flooding. Areas are irregular in shape and range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 12 inches thick. The subsurface layer is very dark gray silty clay loam about 36 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled silty clay loam. In some areas the subsurface layer contains more clay.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3 to 5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsurface layer generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

179D2—Gara loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, well drained or moderately well drained soil is on convex, narrow ridgetops, nose slopes, and valley side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is clay loam about 39 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the upper parts of the side slopes. These soils are less well drained than the Gara soil and are seepy during wet periods. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Gara soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a very low or low supply of available

phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. No limitations or hazards affect planting or harvesting if the proper species are selected for planting and the stand is managed properly.

The land capability classification is IVe.

179E2—Gara loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, well drained or moderately well drained soil is on convex, narrow ridgetops, nose slopes, and valley side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 39 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the upper parts of the side slopes. These soils contain more clay in the subsoil than the Gara soil and are seepy during wet periods. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Gara soil. Surface runoff is rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a very low or low supply of available phosphorus and very low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Further erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

179F—Gara loam, 18 to 25 percent slopes. This steep, well drained or moderately well drained soil is on convex, narrow nose slopes and valley side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 20 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is firm clay loam about 36 inches thick. The upper part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the upper side slopes. These soils contain more clay in the subsoil than the Gara soil and are seepy during wet periods. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Gara soil. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. The surface layer and subsoil typically are medium acid unless the soil is limed. The subsoil generally has a very low or low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas

that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

179F2—Gara loam, 18 to 25 percent slopes, moderately eroded. This steep, well drained or moderately well drained soil is on convex, narrow nose slopes and valley side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 20 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of yellowish brown clay loam subsoil material. The subsoil is yellowish brown, mottled, firm clay loam about 28 inches thick. The substratum to a depth of about 60 inches is yellowish brown clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the upper side slopes. These soils are less well drained than the Gara soil and are seepy during wet periods. They make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Gara soil. Surface runoff is very rapid. Available water capacity is high. The content of organic matter is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a very low or low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. Further erosion is a hazard, and the slope is a limitation. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Seedling mortality and competition from undesirable plants are not likely to be problems on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

192D2—Adair clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on convex, narrow ridgetops, nose slopes, and side slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 6 inches thick. It is mixed with some streaks and pockets of yellowish brown subsoil material. The subsoil extends to a depth of 60 inches or more. The upper part is yellowish brown, friable silty clay loam, and the lower part is yellowish brown and brown, firm clay loam.

Included with this soil in mapping are small areas of Clarinda and Shelby soils. Clarinda soils are on the upper parts of the side slopes and Shelby soils on the lower parts. Clarinda soils are less well drained than the Adair soil, and Shelby soils are better drained and contain less clay in the subsoil. Included soils make up 5 to 10 percent of the unit.

The Adair soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 1.5 to 2.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is medium acid to neutral. It generally has a very low supply of available phosphorus and a very low or low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

211—Edina silt loam, 0 to 1 percent slopes. This nearly level, poorly drained soil is on narrow to broad interstream divides in the loess-covered uplands. Areas are irregular in shape and commonly range from 4 to more than 40 acres in size.

Typically, the surface layer is very dark gray silt loam about 9 inches thick. The subsurface layer is dark gray silt loam about 8 inches thick. The subsoil is about 31 inches of very firm, mottled silty clay and silty clay loam. The upper part is black, the next part is very dark gray, and the lower part is dark grayish brown. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Included with this soil in mapping are small areas of Haig soils. These soils are in the convex areas between shallow depressions and can be drained more easily than the Edina soil. They make up 5 to 10 percent of the unit.

The Edina soil is very slowly permeable. It has a seasonal high water table. Surface runoff is very slow. Available water capacity is high. The shrink-swell potential is very high. The content of organic matter typically is about 2.0 to 3.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is slightly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Obtaining adequate subsurface drainage is very difficult because of the high content of clay in the subsoil. A surface drainage system helps to control ponding and thus helps to prevent the drowning out of crops. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIIw.

220—Nodaway silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom land near the major streams. It is subject to flooding. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The substratum to a depth of about 60 inches is stratified very dark grayish brown, dark grayish brown, and grayish brown silt loam. In some areas the surface layer is loam, silty clay loam, or sandy loam.

Included with this soil in mapping are scattered small areas of the poorly drained Colo soils. These soils make up 5 to 10 percent of the unit.

The Nodaway soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is very high. The content of organic matter typically is about 2 to 3 percent in the surface layer. This layer typically is neutral. The substratum commonly is slightly acid. It generally has a medium supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

222C—Clarinda silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very

dark grayish brown silty clay loam about 6 inches thick. The subsoil to a depth of about 60 inches is firm and very firm, mottled silty clay and clay. The upper part is dark gray, and the lower part is gray.

Included with this soil in mapping are small areas of Adair and Colo soils. Adair soils are on the lower parts of the side slopes, and Colo soils are in the drainageways below the side slopes. Adair soils are better drained than the Clarinda soil, and Colo soils contain less clay and can be drained more easily. Included soils make up 5 to 15 percent of the unit.

The Clarinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is moderately well suited to small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, the wetness is a very serious limitation and erosion a severe hazard. In row cropped areas, erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

222C2—Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 5 inches thick. It is mixed with some streaks and pockets of dark gray silty clay subsoil material. The subsoil to a depth of about 60 inches is firm, mottled silty clay. The upper part is dark gray, and the lower part is gray.

Included with this soil in mapping are small areas of Adair and Colo soils. Adair soils are on the lower parts of the side slopes, and Colo soils are in the narrow drainageways below the side slopes. Adair soils are better drained than the Clarinda soil, and Colo soils contain less clay and can be drained more easily. Included soils make up 5 to 15 percent of the unit.

The Clarinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 2 to 3 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, the wetness is a very serious limitation and further erosion a severe hazard. In row cropped areas, erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

222D2—Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 5 inches thick. It is mixed with some streaks and pockets of dark gray silty clay subsoil material. The subsoil to a depth of about 60 inches is firm, mottled

silty clay. The upper part is dark gray, and the lower part is gray.

Included with this soil in mapping are small areas of Adair and Colo soils. Adair soils are on the lower parts of the side slopes, and Colo soils are in the narrow drainageways below the side slopes. Adair soils are better drained than the Clarinda soil, and Colo soils contain less clay and can be drained more easily. Included soils make up 5 to 15 percent of the unit.

The Clarinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1.5 to 2.0 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, the wetness is a serious limitation and further erosion a severe hazard. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

223C2—Rinda silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, poorly drained soil is on short, convex side slopes and in coves at the head of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 4 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. It is mixed with some streaks and pockets of dark grayish brown silty clay loam subsoil material. The subsoil extends to a depth of more than 60 inches. It is mottled. The upper part is dark grayish brown, friable silty clay loam, and the lower part is dark grayish brown, yellowish brown, light gray, and gray, firm silty clay.

Included with this soil in mapping are small areas of Armstrong soils on the lower parts of the side slopes. These soils are better drained than the Rinda soil and contain less clay. They make up 5 to 15 percent of the unit.

The Rinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, the wetness is a serious limitation and further erosion a severe hazard. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Special high flotation equipment can be used if it is needed during wet periods. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Laying out logging roads or trails on the contour or nearly on the contour helps to control erosion.

The land capability classification is IVe.

223D2—Rinda silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, poorly drained soil is on short, convex side slopes, on convex nose slopes, and in coves at the upper end of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 4 to more than 20 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. It is mixed with streaks and pockets of brown silty clay subsoil material. The subsoil to a depth of about 60 inches is mottled, firm silty clay. The upper part is brown, and the lower part is yellowish brown and gray.

Included with this soil in mapping are small areas of Armstrong soils on the lower parts of the side slopes. These soils are better drained than the Rinda soil and contain less clay. They make up 5 to 15 percent of the unit.

The Rinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, the wetness is serious limitation and further erosion a severe hazard. Erosion can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Special high flotation equipment can be used if it is needed during wet periods. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting.

The land capability classification is IVe.

260—Beckwith silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in plane areas on the tops of ridges in the loess-covered uplands. It is subject to ponding. Areas are irregular in shape and commonly range from 4 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is light brownish gray silt loam about 7 inches thick. The subsoil to a depth of about 60 inches is firm silty clay grading with increasing depth to friable silty clay loam. It is mottled. The upper part is dark grayish brown and grayish brown, and the lower part is light brownish gray and grayish brown.

Included with this soil in mapping are small areas of the moderately well drained Weller soils on the more sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

The Beckwith soil is very slowly permeable. It has a seasonal high water table above or near the surface. Surface runoff is slow or very slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is neutral. The subsoil commonly is strongly acid to neutral. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The wetness is the main limitation. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

A few areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the

surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Erosion is not a serious hazard when the trees are logged or when logging roads are constructed.

The land capability classification is IIIw.

263—Okaw silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on low terraces. It is subject to flooding and ponding. Areas are irregular in shape and commonly range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches or more. It is mottled. The upper part is dark gray, firm silty clay; the next part is dark grayish brown and dark gray, firm silty clay; and the lower part is dark gray, friable silty clay loam.

Included with this soil in mapping are scattered small areas of the somewhat poorly drained Koszta soils. These soils contain less clay in the subsoil than the Okaw soil. They make up 5 to 15 percent of the unit.

The Okaw soil is very slowly permeable. It has a seasonal high water table above or near the surface. Surface runoff is very slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The wetness is the main limitation. Obtaining adequate subsurface drainage is difficult because of the high content of clay in the subsoil. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

A few areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Erosion is not a serious hazard when the trees are logged or when logging roads are constructed.

The land capability classification is IIIw.

273C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on low, slightly concave foot slopes. It is downslope from moderately steep or steep soils that formed in clay loam glacial till. Areas commonly are long and narrow and are 5 to 10 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is about 21 inches thick. The upper part is black loam, the next part is very dark brown clay loam, and the lower part is very dark grayish brown clay loam. The subsoil to a depth of about 60 inches is friable clay loam. The upper part is very dark grayish brown, and the lower part is brown.

Permeability is moderate. Surface runoff is medium. Available water capacity is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer typically is slightly acid. The subsoil commonly is slightly acid or medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

279—Taintor silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad flats in the loess-covered uplands. Areas are irregular in shape and commonly range from 20 to more than 100 acres in size.

Typically, the surface layer is black silt loam about 6 inches thick. The subsurface layer is silty clay loam about 12 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is mottled silty clay loam about 34 inches thick. The upper part is very dark gray and friable, the next part is dark gray and grayish brown and is firm, and the lower part is olive gray and light olive gray and is friable. The substratum to a

depth of about 60 inches is light olive gray, mottled silty clay loam.

Included with this soil in mapping are small areas of Mahaska soils and depressional areas of soils that are subject to ponding. The somewhat poorly drained Mahaska soils are in positions on the landscape similar to those of the Taintor soil. The depressional soils are wetter than the Taintor soil and cannot be drained so easily. Included soils make up 5 to 10 percent of the unit.

The Taintor soil is moderately slowly permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3.5 to 4.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is slightly acid or medium acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A subsurface drainage system is needed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

280—Mahaska silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on narrow flats and the outward edges of moderately broad or broad flats in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 60 acres in size.

Typically, the surface layer is black and very dark gray silty clay loam about 7 inches thick. The subsurface layer is very dark gray silty clay loam about 12 inches thick. The subsoil to a depth of about 60 inches is mottled, friable silty clay loam. The upper part is very dark grayish brown and dark grayish brown, the next part is grayish brown, and the lower part is olive gray. In some small areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Otley and Taintor soils. The moderately well drained Otley soils are on the more sloping parts of the landscape. The poorly drained Taintor soils are in the slightly lower areas. Included soils make up about 5 to 10 percent of the unit.

The Mahaska soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The content of organic matter typically is about 3.5 to 4.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is slightly acid or medium acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated (fig. 9). This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Generally, good tilth can be easily maintained. If cultivated crops are grown, erosion and soil blowing are slight hazards. They can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in the more sloping areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is I.

281B—Otley silty clay loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. It is adjacent to broad flats. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark grayish brown silty clay loam about 9 inches thick. The subsoil is firm silty clay loam about 32 inches thick. The upper part is brown and yellowish brown and is mottled, the next part is mottled grayish brown, yellowish brown, and light brownish gray, and the lower part is light brownish gray and mottled. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Mahaska soils on the less sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Otley soil. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 3 to 4 percent in the surface layer. This layer typically is slightly acid or medium acid unless it is limed. The subsoil commonly is strongly acid to neutral. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a moderate hazard. It can be controlled by a system of conservation tillage that leaves

Figure 9.—A cultivated area of Mahaska silty clay loam, 0 to 2 percent slopes.

crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in some areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a moderate hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classificaton is IIe.

281C—Otley silty clay loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 60 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsoil is firm silty clay loam about 30 inches thick. The upper part is brown, the next part is yellowish brown and mottled, and the lower part is yellowish brown and grayish brown and is mottled. The substratum to a depth of about 60 inches is light grayish brown, mottled silty clay loam.

Included with this soil in mapping are a few small areas of somewhat poorly drained soils in coves. These soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Otley soil. Surface runoff is medium. Available water capacity is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is slightly

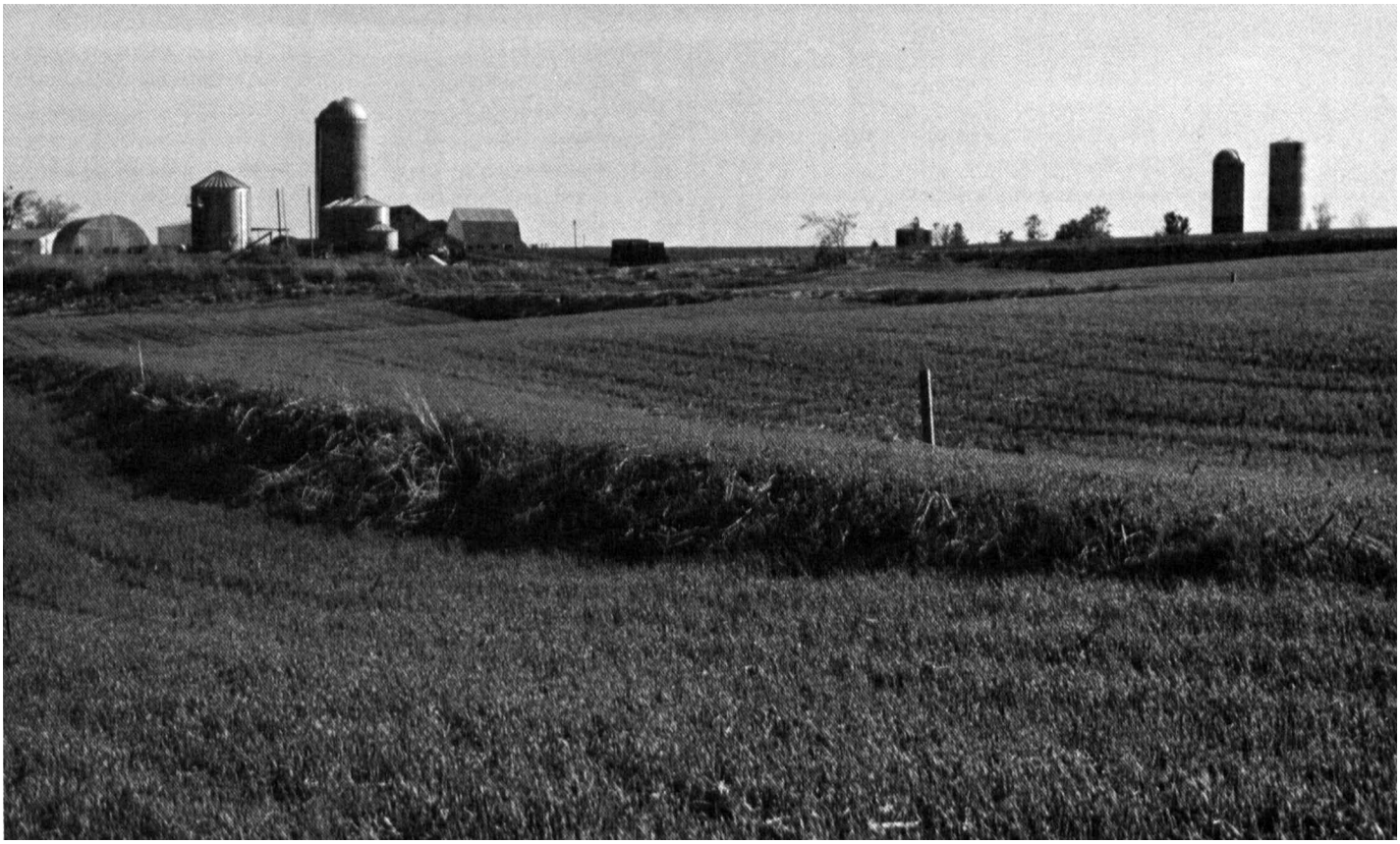


Figure 10.—Tile-intake terraces in an area of Otley silty clay loam, 5 to 9 percent slopes.

acid to strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces (fig. 10), contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

281C2—Otley silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on somewhat long, slightly convex side slopes in the loess-covered uplands. Areas are long and generally several hundred feet wide or are irregularly shaped. They commonly range from 10 to 50 acres in size.

Typically, the surface layer is dark brown silty clay loam about 7 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is firm silty clay loam about 37 inches thick. It is brown in the upper part, yellowish brown in the next part, and olive gray and mottled in the lower part. The substratum to a depth of about 60 inches is olive and olive gray, mottled silty clay loam.

Included with this soil in mapping are a few small areas of somewhat poorly drained soils at the head of drainageways. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Otley soil. Surface runoff is medium. Available water capacity is high. The content of organic matter typically is about 2 to 3 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is slightly acid to strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIIe.

313D—Gosport silt loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is yellowish brown, mottled, extremely firm silty clay loam about 20 inches thick. Light yellowish brown and light gray, coarsely mottled clay shale is at a depth of about 28 inches.

Included with this soil in mapping are small areas where sandstone and limestone crop out. These areas make up about 5 to 10 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is 1.5 to 2.0 percent in the surface layer. This layer is strongly acid unless it is limed. The subsoil has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because it is moderately deep over clay shale and is highly susceptible to erosion. The hazard of erosion is severe in areas cleared for pasture because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

313D2—Gosport silt loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. It is mixed with streaks and pockets of grayish brown silty clay subsoil material. The subsoil is silty clay about 20 inches thick. It is grayish brown and very firm in the upper part; light brownish gray and brownish yellow, mottled, and extremely firm in the next part; and grayish brown and extremely firm in the lower part. Light yellowish brown and light gray, mottled clay shale is at a depth of about 26 inches.

Included with this soil in mapping are small areas where sandstone and limestone crop out. These areas make up about 5 to 10 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. This layer is strongly acid unless it is limed. The subsoil commonly is very strongly acid. It has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because it is moderately deep over clay shale and is highly susceptible to further erosion. The hazard of erosion is severe in areas cleared for pasture because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if

pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

313E—Gosport silt loam, 14 to 18 percent slopes. This moderately steep, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is light olive brown, very firm silty clay; the next part is light olive brown, mottled, firm clay; and the lower part is grayish brown, mottled, extremely firm clay. Gray clay shale is at a depth of about 28 inches.

Included with this soil in mapping are scattered small areas where sandstone crops out and small areas of Douds, Galland, and Lindley soils. Douds and Galland soils typically are on the lower parts of the side slopes, and Lindley soils are on the upper parts. All of the included soils contain less clay than the Gosport soil. Also, they are on more stable slopes. Included areas make up 5 to 15 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. The soil is seepy during wet periods. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 1.0 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. The hazard of erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Competition from undesirable plants can be controlled by careful site preparation or by spraying or cutting.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

313E2—Gosport silt loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. It is mixed with streaks and pockets of yellowish brown silty clay subsoil material. The subsoil is about 19 inches thick. The upper part is yellowish brown, very firm silty clay; the next part is brown, mottled, extremely firm clay; and the lower part is grayish brown, mottled, extremely firm clay. Gray clay shale is at a depth of about 24 inches.

Included with this soil in mapping are scattered small areas where sandstone crops out and small areas of Douds, Galland, and Lindley soils. Douds and Galland soils typically are on the lower parts of the side slopes, and Lindley soils are on the upper parts. All of the included soils contain less clay than the Gosport soil. Also, they are on more stable slopes. Included areas make up 5 to 15 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic

matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is neutral if it is limed. The subsoil commonly is strongly acid. It generally has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. The hazard of further erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Competition from undesirable plants can be controlled by careful site preparation or by spraying or cutting.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

313F—Gosport silt loam, 18 to 25 percent slopes. This steep, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 80 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is dark grayish brown and brown and is very firm, the next part is brown, yellowish brown, and light olive brown, is mottled, and is extremely firm, and the lower part is light brownish gray, mottled, and extremely firm. Light brownish gray, mottled clay shale is at a depth of about 30 inches.

Included with this soil in mapping are scattered small areas where sandstone crops out and small areas of Douds, Galland, and Lindley soils. Douds and Galland soils typically are on the lower parts of the side slopes, and Lindley soils are on the upper parts. All of the included soils contain less clay than the Gosport soil. Also, they are on more stable slopes. Included areas make up 5 to 15 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is very rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Most areas support native hardwoods. This soil is suited to trees. The hazard of erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Competition from undesirable plants is not likely to be a problem on this soil.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

362—Haig silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on broad flats in the loess-covered uplands. Areas are irregular in shape and commonly range from 40 to more than 400 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black silty clay loam about 10 inches thick. The subsoil is about 43 inches thick. It is mottled. The upper part is very dark gray, firm silty clay; the next part is dark gray, firm silty clay grading with increasing depth to olive gray, friable silty clay loam; and the lower part is light olive gray, friable silty clay loam. In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of Edina and Grundy soils. Edina soils are in shallow depressions. They contain more clay than the Haig soil and cannot be drained so easily. The somewhat poorly drained Grundy soils are on the more sloping parts of the landscape. Included soils make up 5 to 10 percent of the unit.

The Haig soil is very slowly permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is neutral to medium acid. It generally has a low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A subsurface drainage system is needed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

364B—Grundy silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on convex ridgetops and the upper side slopes in the loess-covered uplands. It is adjacent to broad flats. Areas are long and narrow or irregularly shaped and commonly range from 20 to more than 80 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 3 inches thick. The subsoil is about 41 inches thick. It is mottled and firm. The upper part is very dark grayish brown silty clay loam, the next part is dark grayish brown and grayish brown silty clay, and the lower part is grayish brown silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Haig soils on the less sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

The Grundy soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 3 to 4 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is slightly acid or medium acid. It generally has a very low or low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion and soil blowing are moderate hazards. They can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in some areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a moderate hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIe.

419D2—Vanmeter silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and generally range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. It is mixed with some streaks and pockets of light yellowish brown silty clay subsoil material. The subsoil is about 19 inches thick. It is mottled light yellowish brown and grayish brown, firm silty clay in the upper part and yellowish brown, mottled, very firm clay in the lower part. Light gray clay shale is at a depth of about 25 inches. In some areas, the surface layer is silt loam and the surface layer and subsoil are more acid.

Permeability is very slow. Surface runoff is rapid. Available water capacity is moderate. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. The surface layer and subsoil typically are moderately alkaline. The subsoil has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 30 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. It is not well suited to terracing because of the moderate depth to clay shale. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard because reestablishing a plant cover is difficult. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. The hazard of further erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

419E2—Vanmeter silty clay loam, 14 to 18 percent slopes, moderately eroded. This moderately steep, moderately well drained soil is on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. Areas are long and narrow or irregularly shaped and generally range from 10 to 30 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. It is mixed with some streaks and pockets of light yellowish brown silty clay subsoil material. The subsoil is about 17 inches thick. It is mottled. The upper part is light yellowish brown, firm silty clay, and the lower part is yellowish brown, very firm clay. Light gray clay shale is at a depth of about 22 inches. In some areas, the surface layer is silt loam and the surface layer and subsoil are more acid.

Permeability is very slow. Surface runoff is rapid. Available water capacity is moderate. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. The surface layer and subsoil typically are moderately alkaline. The subsoil has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 30 inches thick.

Most areas are used for pasture or woodland. This soil generally is unsuited to cultivated crops because of the slope and a severe hazard of further erosion. It is not well suited to terracing because of the moderate depth to clay shale. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard because reestablishing a plant cover is difficult. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. This soil is suited to trees. The hazard of further erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed.

This soil is suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

423D2—Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on the lower side slopes along drainageways that extend into the uplands. Areas are long and irregularly shaped and commonly range from 10 to more than 60 acres in size.

Typically, the surface layer is very dark gray and very dark grayish brown silty clay loam about 7 inches thick. It is mixed with some streaks and pockets of dark grayish brown clay subsoil material. The subsoil is about 45 inches thick. It is firm. The upper part is dark grayish brown and dark gray, mottled clay; the next part is mottled yellowish brown and gray clay; and the lower part is mottled yellowish brown, gray, and light gray clay loam. The substratum to a depth of about 60 inches is mottled yellowish brown and light gray clay loam.

Included with this soil in mapping are small areas of the moderately well drained or well drained Gara soils on the lower parts of the landscape. These soils make up 5 to 15 percent of the unit.

The Bucknell soil is slowly or very slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil is medium acid to very strongly acid. It generally

has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

424E2—Lindley-Keswick loams, 14 to 18 percent slopes, moderately eroded. These moderately steep soils are on short, convex side slopes and convex nose slopes in the uplands. The well drained Lindley soil is on the lower parts of the slopes, and the moderately well drained Keswick soil is on the upper parts. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size. They are about 60 percent Lindley loam and 30 percent Keswick loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Lindley soil is dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of dark yellowish brown clay loam subsoil material. The subsoil is firm clay loam about 35 inches thick. The upper part is dark yellowish brown, the next part is dark brown and mottled, and the lower part is strong brown and yellowish brown. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled clay loam.

Typically, the surface layer of the Keswick soil is very dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of dark yellowish brown clay loam subsoil material. The subsoil extends to a depth of about 60 inches or more. It is firm. The upper part is dark yellowish brown clay loam, the next part is mottled yellowish red and brown clay, and the lower part is mottled strong brown, yellowish red, and grayish brown clay loam.

Included with these soils in mapping are small areas of Clinton, Gosport, and Weller soils. Clinton and Weller soils are on the upper side slopes. They contain less sand than the Lindley and Keswick soils. The moderately well drained Gosport soils are on the lower side slopes. They are moderately deep over clay shale. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Lindley soil and slow in the Keswick soil. The Keswick soil has a seasonal high water table. Surface runoff is rapid on both soils. Available water capacity is high in the Lindley soil and moderate in the Keswick soil. The shrink-swell potential is high in the Keswick soil. The content of organic matter typically is less than 0.5 percent in the surface layer of both soils. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a low or very low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. These soils generally are unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some small areas support native hardwoods. These soils are suited to trees. The hazard of further erosion, the slope, and the seedling mortality rate are the main management concerns. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density.

These soils are suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

425C—Keswick loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on short, convex side slopes and convex nose slopes in the

uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil extends to a depth of about 60 inches or more. It is firm and mottled. The upper part is brown, yellowish red, and strong brown clay loam and clay; the next part is brown, strong brown, and grayish brown clay loam; and the lower part is yellowish brown clay loam.

Included with this soil in mapping are small areas of the moderately slowly permeable Clinton soils on the upper parts of the side slopes. These soils make up 5 to 15 percent of the unit.

The Keswick soil is slowly permeable. It has a seasonal high water table. It is seepy during some wet periods. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

425D—Keswick loam, 9 to 14 percent slopes. This strongly sloping, moderately well drained soil is on short, convex side slopes and convex nose slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil extends to a depth of about 60 inches or more. It is firm. The upper part is yellowish red and brown clay loam and clay; the next part is brown and yellowish brown, mottled clay; and the lower part is strong brown, mottled clay loam.

Included with this soil in mapping are small areas of the moderately slowly permeable Clinton soils on the upper parts of the side slopes. These soils make up 5 to 15 percent of the unit.

The Keswick soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 1.0 to 1.5 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are use for pasture, hay, or row crops. This soil is poorly suited to row crops. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

425D2—Keswick loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on short, convex side slopes and convex nose slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of dark yellowish brown clay loam subsoil material. The subsoil is firm clay loam about 55 inches thick. The upper part is dark yellowish brown, the next part is dark brown and mottled, and the lower part is strong brown and yellowish brown and is mottled.

Included with this soil in mapping are small areas of the moderately slowly permeable Clinton soils on the upper parts of the side slopes. These soils make up 5 to 15 percent of the unit.

The Keswick soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is medium acid or strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, hay, or row crops. This soil is poorly suited to row crops. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

428B—Ely silty clay loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on slightly concave, low foot slopes and alluvial fans. Areas are long and narrow or irregularly shaped and are 5 to 10 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown and very dark gray silty clay loam about 19 inches thick. The subsoil to a depth of about 60 inches is very dark grayish brown, grayish brown, and brown, mottled, friable silty clay loam.

This soil is moderately permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 5 to 6 percent in the surface layer. The surface layer and subsoil typically are neutral if the soil is limed. The subsoil has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion and soil blowing are moderate hazards. They can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a moderate hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IIe.

452C—Lineville silt loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown and brown silt loam about 4 inches thick. The subsoil to a depth of about 60 inches is friable silty clay loam and firm clay loam. The upper part is dark grayish brown and brown; the next part is grayish brown, brown, and strong brown and is mottled; and the lower part is mottled yellowish brown, yellowish red, brown, and strong brown.

This soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. The surface layer and subsoil typically are medium acid unless the soil is limed. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the

Figure 11.—An area of Gosport-Rock outcrop complex, 14 to 40 percent slopes, in the northeastern part of the county.

pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

478G—Gosport-Rock outcrop complex, 14 to 40 percent slopes. This moderately steep to very steep map unit occurs as areas of a moderately well drained Gosport soil closely intermingled with areas of Rock outcrop (fig. 11). Areas are long and moderately wide or are irregularly shaped. They commonly range from 10 to more than 80 acres in size. They are about 55 to 70 percent Gosport silt loam and 20 to 40 percent Rock outcrop. The Gosport soil and Rock outcrop occur as areas so intricately mixed that mapping them separately is not practical.

Typically, the surface layer of the Gosport soil is dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 5 inches thick. The subsoil is about 20 inches thick. The upper part is yellowish brown, very firm silty clay; the next part is light olive brown, mottled, extremely firm clay; and the lower part is grayish brown, mottled, extremely firm clay. Gray clay shale is at a depth of about 30 inches.

Typically, the Rock outcrop is sandstone bedrock. The sandstone beds that crop out range from 2 to 6 feet in thickness in most areas. Small areas adjacent to the sandstone outcrops have a surface layer of sandy loam and a subsoil of loam.

Included with the Gosport soil and Rock outcrop in mapping are small areas of Lindley soils on the upper parts of side slopes. These soils contain less clay than

the Gosport soil. Also, they are on more stable slopes. They make up 5 to 15 percent of the unit.

The Gosport soil is very slowly permeable. It is seepy during wet periods. Surface runoff is very rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a very low supply of available phosphorus and a low supply of available potassium. The root zone is 20 to 40 inches thick.

Most areas are used for pasture or woodland. This map unit generally is unsuited to cultivated crops because of the slope and a severe hazard of erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Ordinary farm machinery cannot be used on these moderately steep to very steep, rocky slopes. Maximum production of grasses and legumes can be achieved if pasture is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture in good condition.

Most areas support native hardwoods. This map unit is suited to trees. The hazard of erosion, the slope, and the seedling mortality rate are the main management concerns. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. This equipment cannot be used in the steeper areas. Special equipment can be used in the areas where the slope is less than 35 percent. Caution in operating this equipment is needed. Competition from undesirable plants is not likely to be a problem on this map unit.

This map unit is suited to woodland wildlife habitat. Excluding livestock from areas where trees and shrubs are planted and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIIe.

484—Lawson silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom land near the major streams (fig. 12). It is subject to flooding. Areas are long and narrow or irregularly shaped and range from 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is very dark grayish brown silt loam about 26 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown and dark grayish brown silty clay loam and silt loam. It is mottled in the lower part. In some areas the surface layer is loam or sandy loam.

Included with this soil in mapping are scattered small areas of the poorly drained Colo soils. These soils have a higher content of clay than the Lawson soil. They make up 5 to 15 percent of the unit.

The Lawson soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The content of organic matter typically is about 3 to 5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsurface layer commonly is slightly acid or neutral. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained and protected from floodwater. A subsurface drainage system is needed. In many areas diversion terraces are needed to protect the soil from the runoff from the higher surrounding areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

594C2—Galland loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained or somewhat poorly drained soil is on high terraces that border stream valleys. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. It is mixed with some streaks and pockets of brown clay loam subsoil material. The subsoil is about 42 inches thick. It is mottled. The upper part is brown, friable clay loam; the next part is brown and strong brown, very firm clay; and the lower part is strong brown and grayish brown, firm clay loam. The substratum to a depth of about 60 inches is brown and yellowish brown, mottled sandy clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of side slopes. These soils are more acid than the Galland soil and are moderately deep over clay shale. They make up 5 to 15 percent of the unit.

The Galland soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid unless it is limed. The

Figure 12.—An area of Lawson silt loam, 0 to 2 percent slopes.

subsoil commonly is strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are used for pasture, hay, or row crops. This soil is moderately suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. A system of conservation tillage that leaves crop residue on the surface helps to prevent excessive soil loss. Grassed waterways help to prevent gully erosion. In some areas farming on the contour and terracing are difficult because slopes are gently rolling and short. In most areas, however, these measures can help to control erosion. Terrace cuts should not expose the clayey subsoil. Exposing the subsoil could result in seepy terrace channels. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

A cover of hay or pasture plants is effective in controlling erosion. A permanent cover of pasture plants slowly increases the organic matter content of the soil. Managing this seepy soil for pasture can be difficult in the spring and early in summer. Permanent pastures can be improved by renovating and reseeding. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and a deterioration of tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

594D2—Galland loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on high terraces that border stream valleys. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of brown clay loam subsoil material. The subsoil

is firm clay loam about 38 inches thick. The upper part is brown, the next part is strong brown and yellowish brown and is mottled, and the lower part is yellowish brown and brownish yellow and is mottled. The substratum to a depth of about 60 inches is yellowish brown and brown, mottled sandy clay loam.

Included with this soil in mapping are small areas of Gosport soils on the lower parts of side slopes. These soils are more acid than the Galland soil and are moderately deep over clay shale. They make up 5 to 10 percent of the unit.

The Galland soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

688—Koszta silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on low stream terraces and high second bottoms. It is subject to rare flooding. Areas are irregular in shape and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark gray silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is friable and firm silty clay loam about 37 inches thick. The upper part is brown and mottled, the next part is dark grayish brown and mottled, and the lower part is mottled grayish brown and yellowish brown. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown silty clay loam.

Included with this soil in mapping are scattered small areas of the poorly drained Okaw soils. These soils make up about 5 to 10 percent of the unit.

The Koszta soil is moderately permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsurface layer and subsoil commonly are neutral to medium acid. The subsoil generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a slight hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is I.

731C2—Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, somewhat poorly drained or moderately well drained soil is on convex ridgetops and short, convex side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 45 inches thick. The upper part is brown, friable silty clay loam that has dark grayish brown mottles; the next part is dark grayish brown and grayish brown, firm silty clay and silty clay loam; and the lower part is light grayish brown, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silty clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the lower parts of the side slopes. These soils contain more clay than the Pershing soil and can be seepy during wet periods. They make up about 5 to 15 percent of the unit.

Figure 13.—An area of Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded, used for hay.

The Pershing soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture (fig. 13). If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

731D2—Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained or moderately well drained soil is on convex ridgetops and short, convex side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. It is mixed with streaks and pockets of brown subsoil material. The subsoil is about 43 inches thick. The upper part is brown, friable silty clay loam that has dark grayish brown mottles; the next part is grayish brown, firm silty clay that has yellowish brown mottles; and the lower part is grayish brown and light brownish gray, friable silty clay loam that has yellowish brown mottles. The substratum to a depth of about 60 inches is light brownish gray silty clay loam.

Included with this soil in mapping are small areas of Armstrong and Rinda soils on the lower parts of the side slopes. These soils contain more clay than the Pershing soil and can be seepy during wet periods. They make up about 5 to 15 percent of the unit.

The Pershing soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture (fig. 14). If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

732C2—Weller silty clay loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops, on convex side slopes, and in coves at the head of drainageways in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 100 acres in size.

Typically, the surface layer is dark brown silty clay loam about 6 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is about 45 inches thick. The upper part is brown, firm silty clay; the next part is brown, friable silty clay loam; and the lower part is grayish brown, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of Ashgrove and Keswick soils, which can be seepy during wet periods. Also included are areas where the lower part of the subsoil is brown clay loam or clay in which the content of sand is more than 20 percent. All of the included soils are on the lower parts of the side slopes. They are less fertile than the Weller soil. They make up 5 to 15 percent of the unit.

The Weller soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil commonly is very strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning

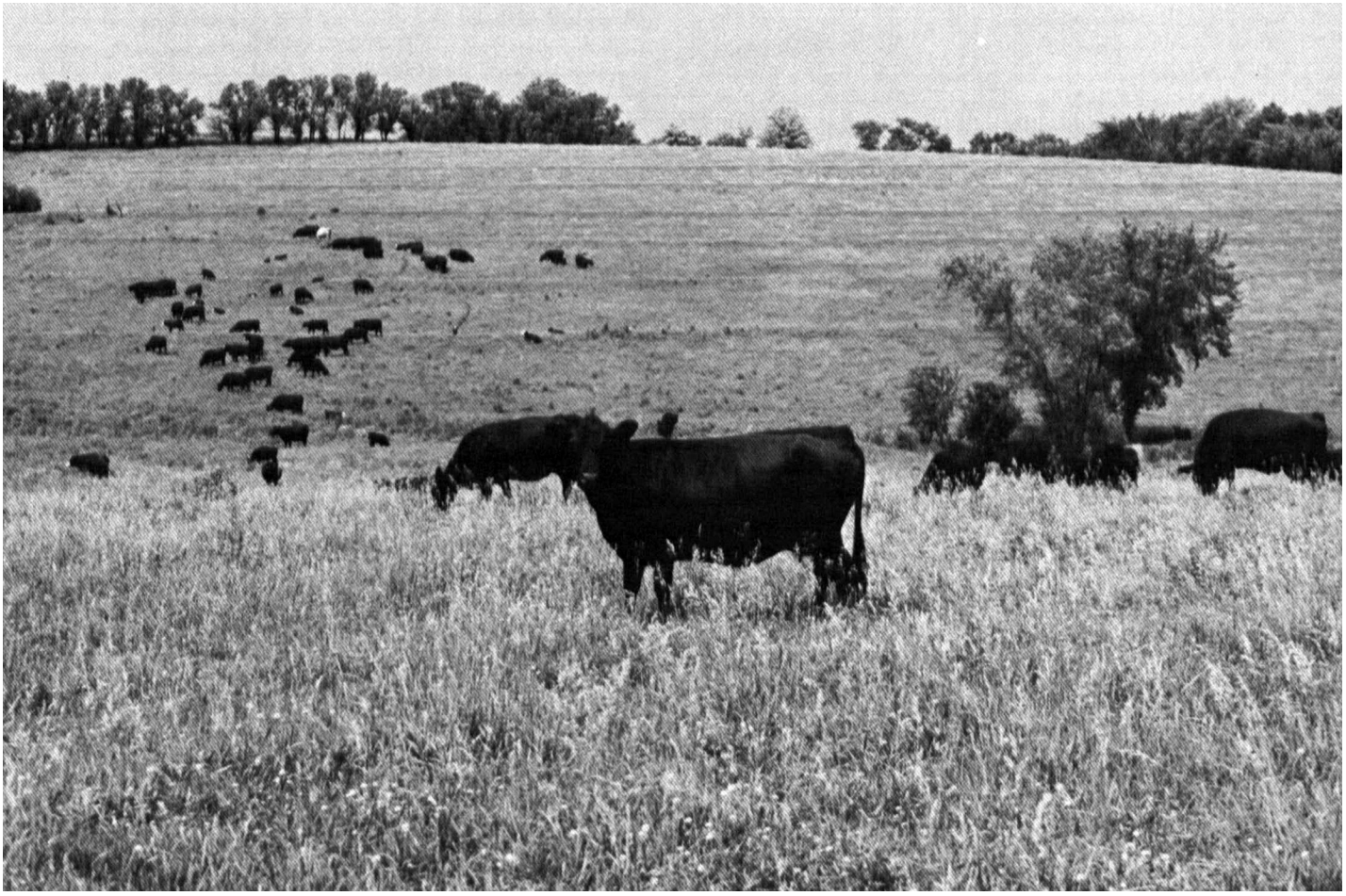


Figure 14.—An area of Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded, used as pasture.

the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

732D2—Weller silty clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained soil is on convex side slopes in the loess-covered uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is about 44 inches thick. The upper part is brown, firm silty clay; the next part is brown, friable silty clay loam; and the lower part is grayish brown, mottled, friable silty clay loam grading with increasing depth to light brownish gray. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. In some small severely eroded areas, the surface layer is dominantly brown silty clay.

Included with this soil in mapping are small areas of Ashgrove and Keswick soils on the lower parts of the side slopes. These soils contain more clay than the Weller soil and can be seepy during wet periods. They make up about 5 to 15 percent of the unit.

The Weller soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is strongly acid unless it is limed. The subsoil generally is very strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

792C2—Armstrong loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained or somewhat poorly drained soil is on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of brown clay loam subsoil material. The subsoil is about 55 inches thick. It is firm. The upper part is brown clay loam and clay mottled with yellowish red, the next part is multicolored clay, and the lower part is yellowish brown, mottled clay loam.

Included with this soil in mapping are small areas of the poorly drained Rinda soils on the upper slopes. These soils contain more clay than the Armstrong soil. They make up 5 to 15 percent of the unit.

The Armstrong soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is slightly acid to strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

792D2—Armstrong loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, moderately well drained or somewhat poorly drained soil is on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 80 acres in size.

Typically, the surface layer is very dark grayish brown loam about 5 inches thick. It is mixed with some streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 46 inches thick. The upper part is brown, the next part is brown and is mottled with yellowish red, and the lower part is strong brown. The substratum to a depth of about 60 inches is dark yellowish brown and yellowish brown clay loam.

Included with this soil in mapping are small areas of the poorly drained Rinda soils on the upper slopes. These soils contain more clay than the Armstrong soil. They make up 5 to 15 percent of the unit.

The Armstrong soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage

that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

795D—Ashgrove silt loam, 9 to 14 percent slopes. This strongly sloping, poorly drained soil is on short, convex side slopes, on convex nose slopes, and in coves at the upper end of drainageways in the uplands. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsurface layer is brown silty clay loam about 5 inches thick. The subsoil is more than 50 inches thick. The upper part is brown, firm silty clay; the next part is grayish brown and light brownish gray, mottled, very firm clay; and the lower part is light brownish gray, mottled, very firm clay. In some small eroded areas, the surface layer is mixed grayish brown and brown silty clay loam.

This soil is very slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water capacity is moderate. The shrink-swell potential is high. The content of organic matter typically is about 1 to 2 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil is medium acid to moderately alkaline. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture, hay, or row crops. This soil is poorly suited to corn, soybeans, and small grain and is moderately suited to poorly suited to grasses and legumes for hay and pasture. If cultivated crops are grown, the wetness is a very serious limitation and erosion is a very severe hazard. Row crops can be grown in some years if the soil is adequately drained and protected against erosion. In many areas a narrow, seepy band is on the upper part of the side slopes. This band commonly remains wet until midsummer. The soil warms slowly in the spring and dries very slowly after rains. Planting is delayed in wet years. Tile drainage is not feasible in this very slowly permeable soil, but inceptor tile can be installed in the upslope adjacent soils. Terraces, contour farming, and a conservation tillage system that leaves crop residue on the surface help to control erosion. In many areas, however, farming on the contour and terracing are difficult because slopes are rolling and short. Terrace cuts should not expose the clayey subsoil. Exposing the subsoil could result in seepy terrace channels. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

A cover of hay or pasture plants is effective in controlling erosion. A permanent cover of pasture plants slowly increases the organic matter content of the soil. Managing this seepy soil for pasture is difficult, particularly in the spring and early in summer. Permanent pastures can be improved by renovating and reseeding. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and a deterioration of tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Special high flotation equipment can be used if it is needed during wet periods. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Erosion is not a serious hazard when the trees are logged or when logging roads are constructed.

The land capability classification is IVe.

822D2—Lamoni clay loam, 9 to 14 percent slopes, moderately eroded. This strongly sloping, somewhat poorly drained soil is on the lower side slopes along drainageways that extend into the uplands. Areas are long and irregularly shaped and commonly range from 10 to more than 60 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. It is mixed with streaks and pockets of dark yellowish brown and yellowish brown subsoil material. The subsoil is about 53 inches thick. The upper part is dark yellowish brown and yellowish brown, firm clay loam; the next part is mottled grayish brown, yellowish brown, and light brownish gray, very firm clay; and the lower part is mottled light brownish gray, yellowish brown, and light olive gray, firm and very firm clay loam.

This soil is slowly permeable. It has a seasonal high water table. Surface runoff is rapid. Available water

capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 1.5 to 2.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid to neutral. It generally has a low supply of available phosphorus and a low or medium supply of available potassium.

Most areas are cultivated. This soil is poorly suited to intensive row cropping. It is best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

The land capability classification is IVe.

832C2—Weller silty clay loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes on loess-covered stream benches. Areas are irregular in shape and commonly are 5 to more than 10 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. It is mixed with some streaks and pockets of brown subsoil material. The subsoil is about 32 inches thick. The upper part is brown and yellowish brown, firm silty clay; the next part is yellowish brown and grayish brown, friable silty clay loam; and the lower part is grayish brown, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam. Stratified, loamy alluvium is at a depth of about 6 feet.

Included with this soil in mapping are small areas of Douds and Galland soils on the lower parts of the side slopes. Douds soils have a higher content of sand than the Weller soil. Galland soils have a strong brown, clayey subsoil and are subject to hillside seepage. Included soils make up 5 to 15 percent of the unit.

The Weller soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 0.5 to 1.0 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

876B—Ladoga silt loam, benches, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops and side slopes on loess-covered stream benches. It is adjacent to narrow or moderately broad flats. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 20 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is dark yellowish brown and mottled, and the lower part is yellowish brown and grayish brown and is mottled. The substratum to a depth of about 60 inches is yellowish brown and grayish brown, mottled silty clay loam. Stratified, loamy alluvium is at a depth of about 8.5 feet.

Permeability is moderately slow. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are

grown, erosion and soil blowing are moderate hazards. They can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in some areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, erosion is a moderate hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIe.

876C2—Ladoga silt loam, benches, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes on loess-covered stream benches. Areas are long and narrow or irregularly shaped and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. It is mixed with streaks and pockets of brown silty clay loam subsoil material. The subsoil is friable silty clay loam about 41 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled silt loam. Stratified, loamy alluvium is at a depth of about 6 feet.

Included with this soil in mapping are small areas of Galland soils on the lower parts of the side slopes. These soils have a strong brown, clayey subsoil and are subject to hillside seepage. They make up 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is medium. Available water capacity is high. The content of organic matter is about 0.5 to 1.5 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a medium supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Seedlings can survive and grow well if competing vegetation is controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

993D2—Gara-Armstrong loams, 9 to 14 percent slopes, moderately eroded. These strongly sloping soils are on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes in the uplands. The well drained or moderately well drained Gara soil is on the lower parts of the slopes, and the moderately well drained or somewhat poorly drained Armstrong soil is on the upper parts. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size. They are about 60 percent Gara loam and 30 percent Armstrong loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Gara soil is very dark grayish brown loam about 7 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 39 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam.

Typically, the surface layer of the Armstrong soil is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of yellowish brown clay loam subsoil material. The subsoil to a depth of about 60 inches is clay loam. The upper part is yellowish brown and friable; the next part is yellowish brown and brown, is mottled with yellowish red, and is firm; and the lower part is yellowish brown and brown.

Included with these soils in mapping are small areas of Pershing, Rinda, and Weller soils on the upper slopes. Pershing and Weller soils contain less clay than the Armstrong and Gara soils. Rinda soils are poorly drained. Included soils make up about 5 to 15 percent of the unit.

The Gara soil is moderately slowly permeable and the Armstrong soil slowly permeable. The Armstrong soil has a seasonal high water table. Surface runoff is rapid on both soils. Available water capacity is high in the Gara soil and moderate in the Armstrong soil. The shrink-swell

potential is high in the Armstrong soil. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer of both soils. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a low or very low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. These soils are poorly suited to intensive row cropping. They are best suited to small grain and to grasses and legumes for hay and pasture. If row crops are grown, further erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

These soils are suited to trees. They generally support trees only in groves and around farmsteads. Seedlings do not survive well on the Armstrong soil. As a result, they should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. No other limitations or hazards affect planting or harvesting.

The land capability classification is IVe.

993E2—Gara-Armstrong loams, 14 to 18 percent slopes, moderately eroded. These moderately steep soils are on short, convex side slopes, narrow ridgetops, and convex nose slopes in the uplands. The well drained or moderately well drained Gara soil is on the lower parts of the slopes, and the moderately well drained or somewhat poorly drained Armstrong soil is on the upper parts. Areas are long and narrow or irregularly shaped and commonly range from 10 to more than 50 acres in size. They are about 60 percent Gara loam and 30 percent Armstrong loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the surface layer of the Gara soil is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of brown clay loam subsoil material. The subsoil is firm clay loam about 39 inches thick. The upper part is brown, the next part is dark yellowish brown, and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is yellowish brown, mottled clay loam.

Typically, the surface layer of the Armstrong soil is very dark grayish brown loam about 6 inches thick. It is mixed with streaks and pockets of yellowish brown clay loam subsoil material. The subsoil to a depth of about 60 inches is clay loam. The upper part is yellowish brown and friable; the next part is yellowish brown and brown, is mottled with yellowish red, and is firm; and the lower part is yellowish brown and brown.

Included with these soils in mapping are small areas of Pershing, Rinda, and Weller soils on the upper slopes. Pershing and Weller soils contain less clay than the Gara and Armstrong soils. Rinda soils are poorly drained. Included soils make up about 5 to 15 percent of the unit.

The Gara soil is moderately slowly permeable and the Armstrong soil slowly permeable. The Armstrong soil has a seasonal high water table. Surface runoff is rapid on both soils. Available water capacity is high in the Gara soil and moderate in the Armstrong soil. The shrink-swell potential is high in the Armstrong soil. The content of organic matter typically is about 0.5 to 1.5 percent in the surface layer of both soils. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a low or very low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for pasture or woodland. These soils generally are unsuited to cultivated crops because of the slope and a severe hazard of further erosion. Managing areas that have been cleared for pasture is difficult because of the slope. Erosion is a severe hazard in these areas because reestablishing a plant cover is difficult. Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture or hayland is tilled, further erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

Some areas support native hardwoods. These soils are suited to trees. Further erosion is a hazard, and the slope is a limitation. Also, seedlings do not survive well on the Armstrong soil. As a result, they should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Laying out logging roads and trails on the contour or nearly on the contour helps to control erosion. Because of the slope, operating logging equipment is somewhat hazardous. Special equipment and caution in operating this equipment are needed. Competition from undesirable plants is not likely to be a problem on these soils.

These soils are suited to woodland wildlife habitat. Excluding livestock from wooded areas, constructing water impoundment reservoirs, planting trees and shrubs, and establishing food plots adjacent to wooded areas maintain or improve the habitat.

The land capability classification is VIe.

1130—Belinda silt loam, benches, 0 to 2 percent slopes. This nearly level, poorly drained soil is on narrow or moderately broad flats on loess-covered stream benches. Areas are irregular in shape and commonly are 5 to more than 10 acres in size.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is dark gray and gray silty clay loam about 10 inches thick. The subsoil is more than 42 inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam; the next part is grayish brown, mottled, very firm silty clay; and the lower part is light brownish gray, mottled, firm silty clay loam. Grayish brown, loamy, stratified alluvium is at a depth of about 8 feet.

Included with this soil in mapping are small areas of the moderately well drained or somewhat poorly drained Pershing soils on the more sloping parts of the landscape. These soils make up 5 to 10 percent of the unit.

The Belinda soil is very slowly permeable. It has a seasonal high water table. Surface runoff is very slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 2 to 3 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are used for cultivated crops or for hay and pasture. This soil is moderately well suited to corn, soybeans, and small grain and is moderately well suited or well suited to grasses and legumes for hay and pasture. Row crops can be grown in many years if the soil is adequately drained. Tile drains generally do not function satisfactorily in this very slowly permeable soil. Open ditches, a surface drainage system, land shaping, and a bedding system help to remove surface water. The soil warms slowly in the spring and dries slowly after rains. In years when rainfall is heavy, planting is delayed.

If this soil is used for pasture, overgrazing or grazing when the soil is too wet causes surface compaction, which results in a deterioration of tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. The equipment limitation, seedling mortality, and plant competition are the main management concerns. Because of the seasonal wetness, equipment should be used only during the drier parts of the year or during winter, when the ground is frozen. Special high flotation equipment can be used if it is needed during wet periods. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand density. Competing vegetation can be controlled by careful site preparation or by spraying or cutting. Erosion is not a serious hazard when the trees are logged or when logging roads are constructed.

The land capability classification is IIIw.

1131C—Pershing silt loam, benches, 5 to 9 percent slopes. This moderately sloping, moderately well drained or somewhat poorly drained soil is on convex ridgetops and side slopes on loess-covered stream benches. Areas are irregular in shape and commonly are 5 to more than 10 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is about 54 inches thick. The upper part is dark grayish brown, friable silty clay loam; the next part is dark grayish brown, yellowish brown, and grayish brown, mottled, firm silty clay; and the lower part is light brownish gray, mottled, friable silty clay loam. The substratum to a depth of about 60 inches is light brownish gray silt loam. Multicolored, loamy, stratified alluvium is at a depth of about 7 feet.

Included with this soil in mapping are small areas of the poorly drained Belinda soils on the less sloping parts of the landscape. These soils make up about 5 to 10 percent of the unit.

The Pershing soil is slowly permeable. It has a seasonal high water table. Surface runoff is medium. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter typically is about 2 to 3 percent in the surface layer. This layer typically is medium acid unless it is limed. The subsoil commonly is strongly acid. It generally has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. It can be controlled in intensively row cropped areas by a system of conservation tillage that leaves crop residue on the surface, terraces, contour farming, grassed waterways, and a cropping sequence that includes grasses and legumes. A combination of these measures is needed in some areas.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition. If the pasture of hayland is tilled, erosion is a severe hazard. As a result, the grasses and legumes should be interseeded into the existing sod.

A few small areas support native hardwoods. This soil is suited to trees. Because they do not survive well, seedlings should be planted at close intervals. Thinning the surviving trees helps to achieve the desired stand

Figure 15.—Excavating in an area of Pits and Dumps.

density. Competing vegetation can be controlled by careful site preparation or by spraying, cutting, or girdling. No other limitations or hazards affect planting or harvesting.

The land capability classification is IIIe.

1279—Taintor silt loam, benches, 0 to 2 percent slopes. This nearly level, poorly drained soil is on narrow or moderately broad flats on high, loess-covered stream benches. Areas are irregular in shape and commonly range from 5 to more than 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is mottled, friable silty clay loam about 44 inches thick. The upper part is dark grayish brown and brown, the next part is dark grayish brown grading with increasing depth to grayish brown, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light brownish gray, mottled silt loam. Stratified, loamy alluvium is at a depth of about 8 feet.

Included with this soil in mapping are small areas of the moderately well drained Ladoga soils on narrow, convex ridgetops. These soils make up about 5 to 10 percent of the unit.

The Taintor soil is moderately slowly permeable. It has a seasonal high water table. Surface runoff is slow. Available water capacity is high. The shrink-swell potential also is high. The content of organic matter is about 3.5 to 4.5 percent in the surface layer. This layer typically is slightly acid unless it is limed. The subsoil commonly is medium acid. It generally has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. A subsurface drainage system is needed. A ridge-till planting system, in which the soil is ridged and row crops are planted on the ridges, helps to overcome the wetness and a low soil temperature.

Maximum production of grasses and legumes can be achieved if pasture or hayland is well managed.

Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture or hayland in good condition.

The land capability classification is IIw.

5020—Pits and Dumps. This map unit consists of pits and dumps where coal has been mined (fig. 15). The excavations are open, trench-type pits that are 40 or more feet deep. The dumps are piles of extremely acid spoil material that are 15 to 30 feet high. The pits and dumps support little or no vegetation. Water accumulates in most of the pits (fig. 16), but it generally has a pH below 4, which is too acid for fish. The idle land between or adjacent to the pits and dumps is eventually vegetated by annual weeds, grasses, and trees after the mining activity has ceased. Areas of this unit are irregular in shape and commonly range from 5 to more than 20 acres in size.

The soil material and the slope vary considerably from area to area. In general, however, permeability is slow or very slow, available water capacity is moderate or high, and the shrink-swell is high. Surface runoff ranges from medium to very rapid, depending on the slope. The soil material typically is extremely acid. It commonly has a very low supply of available phosphorus and potassium. The content of organic matter generally is less than 0.5 percent.

No land capability classification is assigned.

5021—Orthents, hilly. These soils are in dumps where coal has been mined. The dumps consist of acid spoil material mixed with glacial till, loess, and alluvium. They are 15 to 30 feet high. They are vegetated by annual weeds, grasses, and trees. Areas are irregular in shape and commonly range from 5 to more than 20 acres in size.

The soil material and the slope vary considerably from area to area. In general, however, permeability is slow or very slow, available water capacity is moderate or high, and the shrink-swell potential is high. Runoff ranges from medium to very rapid, depending on the slope. The soil material typically is slightly acid to strongly acid. It commonly has a very low supply of available phosphorus and potassium. The content of organic matter generally is less than 0.5 percent.

No land capability classification is assigned.

Figure 16.—An area of Pits and Dumps filled with water.

Figure 17.—An area of Pits, quarries, that is still mined for limestone, which is an important natural resource in the northeastern part of Monroe County.

5030—Pits, quarries. This map unit consists of open pits from which limestone has been removed. The pits are 20 to more than 60 feet deep. They are irregular in shape and commonly are 4 to more than 10 acres in size.

Only one large pit and a few of the small ones are still mined (fig. 17). The inactive pits generally are on private land and are posted. Many are filled with water and stocked with fish.

No land capability classification is assigned.

5040—Orthents, loamy. These soils are in borrow areas, cut and fill areas, sanitary landfills, and reclaimed gravel pits. Areas range from 2 to 20 acres in size. They commonly are square or rectangular, but some are irregularly shaped.

The soil material varies from area to area, but it generally is derived from loamy glacial till. Typically, it is moderately alkaline, calcareous material in which the content of organic matter is less than 1 percent. In areas where topsoil has been replaced, however, reaction is neutral or slightly acid and the content of organic matter is 2 percent or more in the surface layer. The soil material is compacted in many areas.

Corn and soybeans could be grown in most areas that have not been developed for urban uses. In many of these areas, however, the soils are better suited to hay or pasture, at least until tilth and fertility are improved. The more sloping areas are subject to erosion if they are cultivated. Some areas are suitable for wildlife habitat or woodland. Special care is needed in selecting species that are suited to the soil conditions at the specific site.

No land capability classification is assigned.

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland,

pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber or is available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal imputs of energy and economic resources, and farming it results in the least damage to the environment.

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

About 71,000 acres throughout Monroe County, or about 25 percent of the total acreage, meets the soil requirements for prime farmland. About 65,000 acres of this farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for an estimated one-half of the county's total agricultural income each year.

The map units in Monroe County that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by a drainage system. The need for drainage is indicated in parentheses after the name of these soils in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

Use and Management of the Soils

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

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

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

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

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

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

Crops and Pasture

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

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

According to the 1981 Iowa Agricultural Statistics, about 109,390 acres in Monroe County, or 39 percent of the total acreage, is cropland. The main crops are corn and soybeans. Alfalfa or alfalfa-grass is the major hay crop. The acreage used for row crops has increased in recent years, whereas the extent of other land uses has remained about the same. Productivity could be increased and soil conservation enhanced by application of crop production technology to all cropland in the county. This soil survey, which gives the basic characteristics of each kind of soil, can greatly aid in the application of this technology.

The main management needs on the cropland and pasture in Monroe County are measures that help to control erosion and soil blowing, that drain naturally wet soils and seepy areas, and that maintain or improve fertility and tilth.

Water erosion is the major problem on about two-thirds of the cropland and pasture in Monroe County. It is a hazard if the slope is more than 2 percent. Loss of the surface layer through erosion reduces the productivity of soils and results in sedimentation in streams. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a subsoil that is low in fertility, such as Shelby soils, and on soils having a clayey subsoil, such as Adair and Clarinda soils. Preparing a good seedbed and tilling are difficult on eroded soils because the original friable surface layer has been removed or thinned and the more strongly structured subsoil commonly is hard and cloddy after rains or after it has been tilled when wet. Runoff from eroding soils commonly deposits sediment in streams, drainageways, and road ditches. Control of erosion not only helps to maintain the productivity of soils but also improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

Because of a great variety of soils and landscape features, a variety of erosion-control measures are needed in Monroe County. The best measures provide a

protective cover of plants or crop residue, reduce the runoff rate, and increase the rate of water infiltration. Examples are cover crops, contour stripcropping, contour tillage, terraces and diversions, grassed waterways, and conservation tillage. Generally, a combination of several measures is most effective.

A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, where part of the acreage is hayland or pasture, forage crops of grasses and legumes not only provide nitrogen and improve tilth for the next cropping season but also provide a protective plant cover.

A conservation tillage system that leaves a protective amount of crop residue on the surface after planting is effective in controlling erosion, especially on the more sloping soils. Following are examples of the major kinds of conservation tillage. No-till, slot, or zero tillage is a system in which the seedbed is prepared and the seed planted in one operation. The surface is disturbed only in the immediate area of the planted seed row. A protective cover of crop residue is left on at least 90 percent of the surface. Strip-till or till-plant also is a system in which the seedbed is prepared and the seed planted in one operation. Tillage is limited to a strip not wider than one-third of the row. A protective cover of crop residue is left on two-thirds of the surface. Chisel-disk or rotary tillage is a system in which the soil is loosened throughout the field and part of the crop residue is incorporated into the soil. Seedbed preparation and planting can be one or separate operations.

Terraces and diversions control runoff and erosion by reducing the length of slopes. They are most effective on well drained or moderately well drained, gently sloping or moderately sloping soils that have smooth slopes. They are less effective in areas where slopes are irregular or are too steep. Tile-intake terraces help to prevent the accumulation of runoff. If terraces are constructed on soils that formed in loess, such as Arispe, Grundy, and Otley soils, incorporation of the more slowly permeable adjacent soils, such as Adair, Clarinda, Lamoni, and Gosport, should be avoided or minimized. Because of the high content of clay in the more slowly permeable soils, designing and constructing the terraces and revegetating the terrace slope are difficult and seepage can be a problem following construction. In areas of Shelby and other soils having a subsoil that formed partly or entirely in glacial till, the topsoil should be stockpiled when the terraces are constructed and the exposed subsoil should be covered after construction is complete. Diversion terraces commonly are constructed upslope from the Olmitz soils on foot slopes. They help to control the runoff from the adjacent upland slopes.

Contour farming and contour stripcropping effectively control erosion in Monroe County. They are most effective on soils that have smooth, uniform slopes, such as Arispe, Grundy, and Otley soils. Gully-control structures, grassed waterways, and farm ponds help to control erosion in watercourses. The farm ponds also provide a supply of water for livestock and for recreation.

Soil blowing is a hazard on the sandy Sparta soils, which occur as scattered areas along Cedar Creek. If the winds are strong and the soils are dry and bare, soil blowing can damage these soils in a short period. Row crops on these soils and on adjacent soils may also be damaged by the blowing sand. A plant cover, surface mulching, windbreaks, and tillage methods that keep the surface rough minimize soil blowing.

Information about the design of practices that help to control erosion and soil blowing on each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Drainage is a major management concern on about 11 percent of the acreage in Monroe County. Artificial drainage typically is needed on the Colo, Vesser, and Zook soils on flood plains and the Belinda, Haig, and Taintor soils on uplands. Artificially draining poorly drained or very poorly drained soils generally increases productivity and expands the choice of crops that can be grown. The drains should be more closely spaced in the moderately slowly permeable soils than in the more rapidly permeable soils. The slow or very slow permeability in Adair, Clarinda, Lamoni, and other soils that formed in a paleosol on uplands commonly results in seepy areas within the surrounding soils. Installing lateral interceptor tile drains upslope from the slowly or very slowly permeable soils helps to intercept and drain the excess moisture at the point where loess and glacial till are in contact.

Fertility is affected by the supply of available phosphorus and potassium in the subsoil, by reaction, and by the content of organic matter in the surface layer. The fertility level varies widely in the soils of Monroe County. In most of the soils, the supply of available phosphorus and potassium is low or very low and reaction is neutral to strongly acid. On acid soils applications of ground limestone are needed to promote good plant growth. On all soils the kinds and amounts of lime and fertilizer needed should be determined by the results of soil tests, the needs of the crop, and the expected level of yields. Soil tests generally provide the most beneficial information. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime that should be applied.

Tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth generally have a high content of organic matter and are granular and porous. In most of the uneroded upland soils that formed under prairie grasses, the content of organic matter in the surface layer is about 3.0 to 4.5 percent. In the eroded upland soils that formed under prairie grasses, it is less than 1 percent to

3 percent, depending on the degree of erosion that has taken place. It also is less than 1 percent to 3 percent in Gara and Pershing soils, which formed under mixed prairie grasses and deciduous trees. Most of the soils on bottom land have the highest content of organic matter. The content is 4 to 7 percent in the bottom land soils that have a surface layer of silty clay loam. It is lower in the stratified soils that have a surface layer of silt loam, such as Nodaway soils. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth and help to prevent the formation of a surface crust.

The soils that formed in glacial till, such as Adair, Gara, and Shelby soils, commonly have an accumulation of large stones on the surface. These stones can hinder fieldwork unless they are removed.

Most of the permanent pastures in the county support bluegrass. Some are renovated and support birdsfoot trefoil or crownvetch. Other suitable species that are common in the pastured areas are bromegrass, reed canarygrass, orchardgrass, switchgrass, big bluestem, indiangrass, alfalfa, red clover, and ladino clover. Most of the bluegrass pastures are not used as cropland because the soils are too steep for cultivation. Measures that prevent overgrazing are needed, especially on steep slopes, to prevent surface compaction and gully erosion. Maximum production of grasses and legumes can be achieved if the pasture is properly managed. Applications of fertilizer, weed and brush control, rotation and deferred grazing, proper stocking rates, and adequate livestock watering facilities help to keep the pasture in good condition.

Erosion is a severe hazard if the plant cover is destroyed when the more sloping pastures are renovated. Interseeding the grasses and legumes into the existing sod eliminates the need for destroying the plant cover during seedbed preparation. If cultivated crops are to be grown prior to seeding, soil losses can be reduced by conservation tillage, contour farming, and grassed waterways.

Many of the field crops suited to the soils and climate in Monroe County are not commonly grown. These include sorghum and milo, used mainly for silage; wheat; barley; various pasture grasses; various native grasses, such as bluestem, switchgrass, and indiangrass, which produce grass seed; sweet corn; nursery stock; early vegetables; and certain orchard crops. The latest information about managing the soils for these crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

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

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

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

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

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 include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

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

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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

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

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

The original land survey of Iowa, made during the period 1832 to 1859, indicated that about 133,760 acres in Monroe County, or nearly half of the total acreage, was woodland when the first settlers arrived. The early settlers felled a large part of the timber when they cleared the land, primarily for farming. Some of the timber was felled for construction, firewood, and fenceposts. According to the Andreas Atlas, the acreage of woodland declined to an estimated 63,340 acres by 1875. According to Forest Service surveys, it further declined to about 56,000 acres by 1954 and 30,500 acres by 1974. Most of the timber removed during the last 30 years was taken from moderately steep to steep, highly erodible soils that were converted from woodland to agricultural uses.

The principal species on the upland slopes in the county are white oak, northern red oak, black oak, bur oak, shagbark hickory, bitternut hickory, white ash, and green ash. Those in the lowlands and along drainageways include eastern cottonwood, silver maple, green ash, white ash, basswood, and black walnut. Black cherry, though common, is not plentiful, and river birch is in scattered areas along a number of streams. American elm and red elm are abundant, but they generally are small because of the effects of Dutch elm disease. Most of the upland timber grows on Lindley, Weller, Gara, and Armstrong soils. Most of the bottom land timber grows in areas of the Lawson-Nodaway-Colo association, which is described under the heading "General Soil Map Units."

Woodland owners tend to cut the better specimens of the desirable species for lumber and furniture. After this "high-grading," the woodland is of poorer quality because it is regenerated by the poorer trees and less desirable species left behind. Scientific management of a stand of trees can result in the production of an increased volume of more valuable wood and in yields of a consistent amount of firewood from year to year. It also can greatly reduce soil losses and improve the habitat for wildlife.

Woodland can produce the best wood crop only if it is well managed. It should be protected from fire and from destructive grazing. The best potential trees should be allowed to grow. The undesirable trees and vines that compete with the best trees for moisture, nutrients, and light should be removed. After some of the best trees are harvested, their growing space can be occupied by younger trees. The volume harvested during a designated period should not exceed the growth of the remaining trees during the same period.

Most of the woodland in the county is lightly to heavily pastured. Grazing by livestock can result in sparse, poor quality woodland. If livestock graze in a stand of timber, their hooves damage the base of the larger trees, damage or destroy young trees, and compact the soil. Also, the animals selectively browse on certain young trees.

The suitability of different kinds of soil for trees varies greatly. The soil conditions under which different species can grow also vary greatly. Green ash, for example, can grow in a poorly drained soil and in a droughty soil on a south-facing slope. Most species cannot grow under such a wide range of soil conditions. Soils on north- and east-facing slopes are better suited to trees than are soils on south- and west-facing slopes. Generally, the deep, well drained or moderately well drained soils that are moderately fertile or highly fertile are well suited to trees. If the subsoil is slowly permeable, root development is restricted.

Further information about woodland management, tree planting, and insect and disease control can be obtained from the Monroe County Soil Conservation District and from the Iowa Conservation Commission.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops.

Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each suitable soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

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

Trees to plant are those that are suited to the soils and to commercial wood production.

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 insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water

impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

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.

Wildlife Habitat

Monroe County supports many kinds of wildlife. These wildlife resources have a positive effect on the local economy, mainly because of the opportunities for hunting and fishing resulting from the kind and abundance of wildlife in the county. Also, songbirds and hawks, owls, snakes, and other predators are beneficial because they control rodents and undesirable insects.

The soils in the county indirectly affect the kind and abundance of wildlife through their effect on vegetation and land use. Topography affects wildlife through its effect on land use. The undisturbed vegetation in moderately steep and steep areas, such as many areas of Lindley soils, is valuable to wildlife. Planting suitable vegetation where needed on the more sloping prairie soils, such as Shelby, can improve the habitat for the desirable kinds of wildlife. The nearly level Edina and Haig soils generally are cropped intensively. They provide only limited shelter and nesting areas for wildlife, but they also provide corn and small grain for feed. Much of the wildlife in the county inhabits areas of the strongly sloping to steep Gara, Lindley, Shelby, and Armstrong soils in the uplands. Because these soils are along the streams throughout the county, the wildlife is well distributed.

Skunk, opossum, raccoon, squirrel, and cottontail rabbit generally are abundant in the uplands. White-tailed deer frequent areas of the Lawson-Nodaway-Colo association, which is described under the heading "General Soil Map Units." They also frequent the adjacent wooded areas. Muskrat, mink, and some beaver frequent the creeks throughout the county. They probably are most numerous in areas of the Lawson-Nodaway-Colo association.

Quail are plentiful throughout the county. The number of pheasants, which were introduced to the county some years ago, is increasing in areas of the Otley-Mahaska and Arispe-Haig-Grundy associations. If habitat is adequate and reproduction is normal, annual hunting does not significantly decrease the number of most game species.

Some marsh areas along creeks provide good habitat for waterfowl, such as ducks and geese (fig. 18). The Colo and Nodaway soils on bottom land provide sites for dikes and impoundments, which improve the habitat for waterfowl. These areas are suitable sites for hunting blinds. The soils also provide food and cover.

Fish, mainly bullheads and carp, are fairly plentiful in the major streams. Many privately owned artificial ponds that range from 0.5 acre to 15 acres in size are well distributed throughout the county. Some well managed

Figure 18.—An area of marsh along Cedar Creek that provides habitat for waterfowl.

ones provide excellent fishing for bass, bluegill, and catfish. Internal drainage, available water capacity, texture of the subsoil, and permeability are important factors affecting the selection of sites for stocked farm ponds and the development of habitat for waterfowl. Several watershed structures provide excellent fishing and enhance the habitat for wildlife. Rathbun Reservoir, a permanent pool about 11,000 acres in size, is one of the largest bodies of water in Iowa. It has good potential for fishing and for habitat for various kinds of waterfowl. Many areas of the Arispe-Haig-Grundy and Pershing-Gara-Armstrong associations adjacent to the reservoir are suitable for food plantings that improve the habitat for waterfowl.

Although many areas in the county are suitable as wildlife habitat, many more could be improved or developed. Generally, some soils on each farm support good wildlife habitat if they are properly managed. Small, irregularly shaped areas of limited value for other uses can be developed as wildlife habitat. Examples are many areas of the strongly sloping to steep Adair, Armstrong, Gara, and Lindley soils. Brushy or wooded areas can be fenced so that food and cover are not destroyed by livestock. The borders of fields can be planted to grasses and legumes. These areas should not be clipped, especially during the nesting season for upland birds.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in

planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

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

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

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

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

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

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 12 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 are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

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

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

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 calcium carbonate affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

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

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 13 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 due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 13 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, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

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

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

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

Plant growth is affected by 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, and bedrock.

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 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 or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

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

Water Management

Table 15 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 are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. 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 potential 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 a high content of calcium carbonate. 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 and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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

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

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

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

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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

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

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, 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, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, 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, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

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

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

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

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

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

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

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

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, 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 of 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.

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

In table 18, some soils are assigned to two hydrologic groups. The first letter is for drained areas, and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

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

delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is 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.

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*14*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

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

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Cumulic Haplaquolls.

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

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*12*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*14*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Adair Series

The Adair series consists of moderately well drained or somewhat poorly drained, slowly permeable soils on the convex summits of narrow interfluves and on convex side slopes in the uplands. These soils formed in an exhumed paleosol that weathered from glacial till. The native vegetation was tall prairie grasses. Slopes range from 9 to 14 percent.

These soils are taxadjuncts to the Adair series because they lack a mollic epipedon.

Adair soils are similar to Lamoni soils and commonly are adjacent to Arispe, Grundy, and Mahaska soils.

Lamoni soils do not have mottles with hue of 7.5YR or redder in the upper part of the Bt horizon, do not have a stone line, and have mottles with chroma of 2 in the lower part of the B horizon and in the C horizon. Arispe, Grundy, and Mahaska soils are higher on the landscape than the Adair soils. Also, they have a lower content of sand and pebbles in the solum. They do not have hue of 7.5YR or redder in the upper part of the B horizon.

Typical pedon of Adair clay loam, 9 to 14 percent slopes, moderately eroded, about 500 feet south and 1,000 feet east of the center of sec. 35, T. 71 N., R. 19 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of yellowish brown (10YR 5/4) subsoil material; weak fine subangular blocky structure parting to moderate very fine granular; friable; neutral; abrupt smooth boundary.

BA—6 to 10 inches; yellowish brown (10YR 5/4 and 5/6) silty clay loam; weak very fine subangular blocky structure parting to weak fine granular; friable; stone line at a depth of about 10 inches; medium acid; abrupt smooth boundary.

2Bt1—10 to 15 inches; yellowish brown (10YR 5/4) and brown (10YR 5/3) clay loam; many fine distinct red (2.5YR 4/6 and 4/8) mottles; weak very fine subangular blocky structure; firm; thin discontinuous clay films; medium acid; abrupt smooth boundary.

2Bt2—15 to 25 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct yellowish red (5YR 5/8), many fine distinct strong brown (7.5YR 5/6), and few fine faint grayish brown (2.5Y 5/2) mottles; firm; common distinct clay films; medium acid; clear smooth boundary.

2Bt3—25 to 40 inches; yellowish brown (10YR 5/6) and brown (10YR 5/3) clay loam; weak very fine prismatic structure parting to weak very fine subangular blocky; firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

2Bt4—40 to 60 inches; yellowish brown (10YR 5/6) and brown (10YR 4/3) clay loam; weak very fine prismatic structure parting to moderate very fine subangular blocky; firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); neutral.

The thickness of the solum ranges from 40 to 65 inches. The thickness of the Bt horizon, the depth to a pebble band, the depth to the horizon having the highest content of clay, and the depth to carbonates decrease as the slope increases.

The A horizon is very dark gray (10YR 3/1), black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The upper part of the 2Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 3 to 5, and chroma of 3 to 8. These are either the matrix colors or the colors of the many mottles. The content of clay in the upper part of the 2Bt horizon commonly is 38 to 46 percent.

Arispe Series

The Arispe series consists of moderately well drained or somewhat poorly drained, moderately slowly permeable soils on short, convex side slopes and in coves at the head of drainageways in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 5 to 9 percent.

Arispe soils are similar to Grundy and Mahaska soils and commonly are adjacent to Clarinda and Grundy soils. Grundy soils have a higher content of clay than the Arispe soils. Also, they are higher on the landscape. Mahaska soils have a mollic epipedon that is 14 to 24 inches thick. They are deeper to the horizon that has the highest content of clay than the Arispe soils. Clarinda soils are downslope from the Arispe soils. They formed in a gray, clayey paleosol.

Typical pedon of Arispe silty clay loam, 5 to 9 percent slopes, about 700 feet north and 1,880 feet west of the center of sec. 5, T. 72 N., R. 16 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

BA—10 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common fine faint brown (10YR 4/3) mottles; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bt—14 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

Btg1—21 to 33 inches; grayish brown (10YR 5/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); very dark gray (10YR 3/1) root channels; medium acid; clear smooth boundary.

Btg2—33 to 41 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent yellowish red (5YR 5/8) mottles; weak fine prismatic structure; firm; thin discontinuous clay films; very dark gray (10YR 3/1) root channels; slightly acid; gradual smooth boundary.

Btg3—41 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam; common coarse prominent strong brown (7.5YR 5/6) mottles; weak fine prismatic

structure; firm; thin discontinuous clay films; common very dark gray (10YR 3/1) root channels; neutral; gradual smooth boundary.

Cg—46 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common coarse prominent yellowish red (5YR 5/8) mottles; massive; firm; common very dark gray (10YR 3/1) root channels; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is 10 to 14 inches thick.

The Ap or A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The BA horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The upper part of the Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The content of clay in the upper 20 inches of the argillic horizon ranges from 35 to 40 percent. The lower part of the Btg horizon has hue of 2.5Y or 5Y, value of 4 to 6, chroma of 1 or 2.

Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded, is a taxajunct to the series because it lacks a mollic epipedon.

Armstrong Series

The Armstrong series consists of moderately well drained or somewhat poorly drained, slowly permeable soils on the convex summits of interfluves and convex side slopes in the uplands. These soils formed in loess or loess and pedisediment and in the underlying paleosol weathered from glacial till. The native vegetation was mixed prairie grasses and deciduous trees. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Armstrong series because they have a thinner dark surface layer than is definitive for the series.

Armstrong soils are similar to Lineville soils and commonly are adjacent to Gara and Pershing soils. Lineville soils contain less clay in the upper 20 inches of the argillic horizon than the Armstrong soils. Also, they are deeper to a hue redder than 10YR. The moderately well drained or well drained Gara soils are lower on the landscape than the Armstrong soils. Also, they have a lower content of clay in the upper part of the B horizon. Pershing soils have a lower content of sand in the solum than the Armstrong soils. Also, they are higher on the landscape.

Typical pedon of Armstrong loam, 5 to 9 percent slopes, moderately eroded, about 1,660 feet east and 400 feet south of the center of sec. 30, T. 71 N., R. 19 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pockets of brown (7.5YR 4/4) clay loam subsoil material; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.

BA—5 to 8 inches; brown (7.5YR 4/4) clay loam; very dark grayish brown (10YR 3/2) coatings on peds; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings; stone line in the lower part of the horizon; strongly acid; gradual smooth boundary.

2Bt1—8 to 16 inches; brown (7.5YR 4/4) clay; common fine faint yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; few pebbles; strongly acid; gradual smooth boundary.

2Bt2—16 to 25 inches; mottled brown (7.5YR 4/4), yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4), and grayish brown (2.5Y 5/2) clay; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous clay films; few pebbles; strongly acid; clear smooth boundary.

2Bt3—25 to 42 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; few pebbles; slightly acid; gradual smooth boundary.

2Bt4—42 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure; firm; thin discontinuous clay films on prisms; few pebbles; few dark concretions (iron and manganese oxides); slightly acid.

The thickness of the solum ranges from 42 to 80 inches. The thickness of the A horizon, the depth to the horizon having the highest content of clay, the maximum content of clay, the thickness of Bt horizon, the depth to carbonates, and the thickness of the solum typically decrease with increasing slope.

The A or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It typically is loam, but the range includes silt loam, silty clay loam, and clay loam. The upper part of the 2Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Its content of clay ranges from 36 to 48 percent.

Ashgrove Series

The Ashgrove series consists of poorly drained, very slowly permeable soils on convex side slopes and in coves at the head of drainageways that dissect nearly level uplands. These soils formed in an exhumed, gray, clayey paleosol that weathered from glacial till. The native vegetation was deciduous trees. Slopes range from 9 to 14 percent.

Ashgrove soils are similar to Rinda soils and commonly are adjacent to Lindley and Weller soils. The A horizon of Rinda soils is thicker than that of the Ashgrove soils, and the E horizon is less distinct. Lindley

soils are downslope from the Ashgrove soils. They formed in clay loam glacial till. Weller soils are in upslope areas on the less sloping parts of the landscape. They formed in loess.

Typical pedon of Ashgrove silt loam, 9 to 14 percent slopes, about 1,120 feet south and 1,300 feet west of the center of sec. 8, T. 72 N., R. 18 W.

A—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; neutral; abrupt smooth boundary.
E—5 to 10 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.
BE—10 to 15 inches; brown (10YR 4/3) silty clay; moderate fine subangular blocky structure; firm; few small pebbles; medium acid; clear smooth boundary.
2Btg1—15 to 23 inches; grayish brown (2.5Y 5/2) clay; few fine faint dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; very firm; thin discontinuous clay films; few small pebbles; medium acid; gradual smooth boundary.
2Btg2—23 to 31 inches; grayish brown (2.5Y 5/2) clay; few fine faint dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; few small pebbles; slightly acid; clear smooth boundary.
2Btg3—31 to 42 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) clay; common medium distinct dark yellowish brown (10YR 4/4 and 4/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; few small pebbles; slightly acid; clear smooth boundary.
2Btg4—42 to 60 inches; light brownish gray (2.5Y 6/2) clay; few fine faint dark yellowish brown (10YR 4/4 and 4/6) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; few small pebbles; moderately alkaline.

The thickness of the solum typically is more than 60 inches but ranges from 42 to 84 inches. The A horizon is very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). The BE horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The 2Btg horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6, and chroma of 1 to 3.

Beckwith Series

The Beckwith series consists of poorly drained, very slowly permeable soils in slight depressions and plane areas on the tops of upland ridges. These soils formed in loess. The native vegetation was trees. Slopes range from 0 to 2 percent.

Beckwith soils are similar to Belinda and Okaw soils and commonly are adjacent to Belinda and Weller soils. Belinda soils are on upland divides. Their surface layer is darker than that of the Beckwith soils. Okaw soils contain more clay in the C horizon than the Beckwith soils and have a lower B to C clay ratio. Weller soils generally are lower on the landscape than the Beckwith soils and are more sloping. Also, they have a browner B horizon.

Typical pedon of Beckwith silt loam, 0 to 2 percent slopes, about 2,000 feet east and 100 feet south of the northwest corner of sec. 17, T. 71 N., R. 16 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak fine granular; friable; many fibrous roots; neutral; abrupt smooth boundary.
E—6 to 13 inches; light brownish gray (10YR 6/2) silt loam, white (10YR 8/1) and light gray (10YR 7/2) dry; moderate fine platy structure; friable; many fibrous roots; strongly acid; abrupt smooth boundary.
Btg1—13 to 23 inches; grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) silty clay; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fibrous roots; thin discontinuous clay films; thin discontinuous silt coatings; strongly acid; clear smooth boundary.
Btg2—23 to 31 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silty clay; few medium faint dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; few fibrous roots; thin discontinuous clay films; strongly acid; gradual smooth boundary.
Btg3—31 to 39 inches; grayish brown (2.5Y 5/2) silty clay; few medium faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Btg4—39 to 46 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay; many medium faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; few dark root channels; thin discontinuous clay films; few dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.
Btg5—46 to 60 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam; few fine distinct dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 4/6) mottles; massive; friable; few dark root channels; thin discontinuous

clay films; few dark concretions (iron and maganese oxides); slightly acid.

The thickness of the solum ranges from 42 to 72 inches. The A horizon in uncultivated areas is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2). The E horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). The upper part of the Btg horizon is dark grayish brown (2.5Y 4/2), grayish brown (2.5Y 5/2), or light brownish gray (2.5Y 6/2). Its content of clay ranges from 42 to 50 percent. The lower part of the Btg horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2.

Belinda Series

The Belinda series consists of poorly drained, very slowly permeable soils on narrow or moderately broad upland divides. These soils formed in loess. The native vegetation was mixed grasses and deciduous trees. Slopes range from 0 to 2 percent.

Belinda soils are similar to Beckwith soils and commonly are adjacent to Pershing soils. The Ap horizon of Beckwith soils is lighter colored than that of the Belinda soils. The moderately well drained or somewhat poorly drained Pershing soils are on ribbed interfluves that slope away from the Belinda soils on divides. They are gently sloping and moderately sloping.

Typical pedon of Belinda silt loam, 0 to 2 percent slopes, about 1,370 feet east and 420 feet north of the southwest corner of sec. 31, T. 72 N., R. 17 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak very thin platy and weak very fine granular structure; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; neutral; clear smooth boundary.

E1—6 to 9 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; moderate medium platy structure; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; few dark concretions (iron and manganese oxides); neutral; clear smooth boundary.

E2—9 to 15 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; moderate thin platy structure; friable; nearly continuous silt coatings on peds, light gray (10YR 7/1) dry; few dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

E3—15 to 18 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silt loam, light gray (2.5Y 7/2) dry; few very dark grayish brown (10YR 3/2) coatings on peds; weak medium platy structure; friable; thin discontinuous silt coatings, white (10YR 8/1) dry; few dark concretions (iron and manganese oxides); strongly acid; abrupt smooth boundary.

BE—18 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; discontinuous grayish brown (10YR 5/2) coatings; moderate fine subangular blocky structure; firm; thin discontinuous silt coatings, light gray (10YR 7/1) dry; few dark concretions (iron and manganese oxides); strongly acid; abrupt smooth boundary.

Btg1—20 to 23 inches; dark grayish brown (10YR 4/2) silty clay; very dark gray (10YR 3/1) and dark brown (10YR 3/3) coatings on peds; few faint olive brown (2.5Y 4/4) mottles; strong very fine subangular blocky structure; very firm; thick continuous clay films; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Btg2—23 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay; very dark grayish brown (2.5Y 3/2) coatings on faces of peds; few fine faint olive brown (2.5Y 4/4) mottles; strong fine subangular blocky structure; very firm; thick continuous clay films; few fine dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg3—33 to 41 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; thick nearly continuous clay films; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BCg—41 to 60 inches; mottled yellowish brown (10YR 5/4) and olive gray (5Y 5/2) silty clay loam; weak medium prismatic structure; firm; thin discontinuous clay films on faces of prisms; common dark concretions (iron and manganese oxides); medium acid.

The solum is 60 inches or more thick. The E horizon is dark gray (10YR 4/1) to light brownish gray (2.5Y 6/2) in the lower part. The Btg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. It typically is silty clay in which the content of clay ranges from 42 to 48 percent.

Bucknell Series

The Bucknell series consists of somewhat poorly drained, slowly permeable or very slowly permeable soils on the convex summits of narrow interfluves and on convex side slopes. These soils formed in a partly truncated, exhumed, clayey paleosol that weathered from glacial till. The native vegetation was mixed grasses and trees. Slopes range from 9 to 14 percent.

Bucknell soils are similar to Rinda soils and commonly are adjacent to Gara and Pershing soils. Rinda soils contain more clay in the lower part of the Bt horizon than the Bucknell soils. Gara soils are fine-loamy and have a higher chroma in the upper part of the B horizon than the Bucknell soils. Pershing soils formed in loess. They have a higher chroma in the upper part of the B

horizon than the Bucknell soils. Also, they are higher on the landscape.

Typical pedon of Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded, about 800 feet north and 400 feet west of the center of sec. 21, T. 73 N., R. 19 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; mixed with streaks and pockets of dark grayish brown (10YR 4/2) subsoil material; weak medium subangular blocky structure parting to moderate fine platy and granular; friable; thin discontinuous silt coatings, light gray (10YR 7/1) dry; slightly acid; clear smooth boundary.

BE—7 to 10 inches; dark grayish brown (2.5Y 4/2) clay; few fine distinct yellowish brown (10YR 5/6) mottles; moderate very fine and fine subangular blocky structure; firm; thin discontinuous silt coatings, light gray (10YR 7/1) dry; very strongly acid; gradual smooth boundary.

Bt1—10 to 18 inches; dark gray (10YR 4/1) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; thin discontinuous silt coatings, light gray (10YR 7/1) dry; very strongly acid; gradual smooth boundary.

Bt2—18 to 27 inches; mottled yellowish brown (10YR 5/4 and 5/8) and gray (10YR 5/1) clay; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous clay films; thin discontinuous silt coatings, light gray (10YR 7/1) dry; very strongly acid; gradual smooth boundary.

Bt3—27 to 43 inches; mottled yellowish brown (10YR 5/6 and 5/8) and gray (10YR 5/1) clay loam; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.

Bt4—43 to 52 inches; mottled yellowish brown (10YR 5/6) and light gray (5Y 7/2) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.

C—52 to 60 inches; mottled yellowish brown (10YR 5/6) and light gray (5Y 7/1) clay loam; massive; firm; medium acid.

The solum ranges from 40 to 60 inches in thickness. It typically is medium acid to very strongly acid in the most acid part.

The Ap horizon typically is silty clay loam, but the range includes clay loam and loam. The Bt horizon generally is mottled and has hue of 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 1 to 8. The maximum content of clay is about 50 percent. It generally is within 10 to 18 inches of the surface. The C horizon has colors similar to those of the B horizon.

Clarinda Series

The Clarinda series consists of poorly drained, very slowly permeable soils on short, convex side slopes and in coves at the head of drainageways in the uplands. These soils formed in a gray, clayey paleosol weathered from glacial till. The native vegetation was prairie grasses. Slopes range from 5 to 14 percent.

Clarinda soils are similar to Lamoni soils and commonly are adjacent to Adair, Lamoni, and Shelby soils. The adjacent soils generally are lower on the landscape than the Clarinda soils and contain less clay in the solum. Also, Adair soils have a redder B horizon that commonly has a stone line in the upper part.

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, about 820 feet north and 540 feet east of the southwest corner of sec. 21, T. 71 N., R. 19 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; few fibrous roots; strongly acid; clear smooth boundary.

AB—6 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; few fibrous roots; strongly acid; clear smooth boundary.

2Btg1—12 to 17 inches; dark gray (10YR 4/1) silty clay; few fine faint strong brown (7.5YR 4/6) and brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few fibrous roots; thick continuous clay films; strongly acid; clear smooth boundary.

2Btg2—17 to 25 inches; dark gray (10YR 4/1) silty clay; few fine faint strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; few fibrous roots; thick continuous clay films; strongly acid; gradual smooth boundary.

2Btg3—25 to 33 inches; gray (5Y 5/1) clay; few fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very firm; thin continuous clay films; common fine white sand grains; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Btg4—33 to 43 inches; gray (5Y 5/1) clay; few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very firm; thin discontinuous clay films; common fine white sand grains; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Btg5—43 to 60 inches; gray (5Y 5/1) clay; common fine faint strong brown (7.5YR 4/6) and brown

(7.5YR 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; very firm; thin discontinuous clay films; common fine white sand grains; few dark concretions (iron and manganese oxides); neutral.

The solum commonly is more than 60 inches thick. The A horizon typically formed in loess or silty sediments. It is 10 to 18 inches thick. It is black (10YR 2/1) to very dark grayish brown (10YR 3/2). The 2B horizon typically is about 5 feet thick, but it ranges from 3 to more than 10 feet in thickness. It is silty clay or clay in which the maximum clay content ranges from 45 to 58 percent. The distinctly gleyed part of this horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma dominantly of 1.

Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded, and Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded, are taxadjuncts to the series because they lack a mollic epipedon.

Clinton Series

The Clinton series consists of moderately well drained, moderately slowly permeable soils on the convex summits of interfluves and the upper side slopes in the uplands. These soils formed in loess. The native vegetation was deciduous trees. Slopes range from 9 to 14 percent.

Clinton soils are similar to Ladoga soils and commonly are adjacent to Ladoga and Gosport soils. The A horizon of Ladoga soils is thicker than that of the Clinton soils and has value of 3 or less when moist. Gosport soils formed in a thin silty mantle and in the underlying material weathered from clayey shale. They are downslope from the Clinton soils.

Typical pedon of Clinton silt loam, 9 to 14 percent slopes, about 800 feet west and 2,240 feet south of the northeast corner of sec. 5, T. 73 N., R. 16 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

E1—3 to 6 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) and light gray (10YR 7/2) dry; weak thin platy structure; friable; strongly acid; gradual smooth boundary.

E2—6 to 13 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak medium subangular blocky structure; friable; strongly acid; clear smooth boundary.

Bt1—13 to 19 inches; yellowish brown (10YR 5/4) silty clay loam; few brown (10YR 4/3) coatings; moderate fine subangular blocky structure; friable; thin discontinuous clay films; thin discontinuous silt coatings; strongly acid; gradual smooth boundary.

Bt2—19 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thick discontinuous clay films; thin discontinuous silt coatings; strongly acid; gradual smooth boundary.

Bt3—26 to 31 inches; yellowish brown (10YR 5/4) silty clay; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thick discontinuous clay films; strongly acid; diffuse smooth boundary.

Bt4—31 to 46 inches; yellowish brown (10YR 5/6) silty clay loam; many medium distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few fine dark accumulations (iron and manganese oxides); strongly acid; diffuse smooth boundary.

C—46 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) mottles; massive; friable; very dark gray (10YR 3/1) root channels; medium acid.

The thickness of the solum ranges from 42 to 84 inches. The thickness of the A and Bt horizons, the depth to the maximum content of clay, the maximum content of clay, and the depth to grayish mottles decrease with increasing slope. Pedons in cultivated areas have an Ap horizon of dark grayish brown (10YR 4/2) or brown (10YR 4/3) silty clay loam. The content of clay in the Bt horizon is 36 to 42 percent. In some pedons the C horizon is silt loam.

Colo Series

The Colo series consists of poorly drained, moderately permeable soils on flood plains and alluvial fans. These soils formed in alluvium. The native vegetation was grasses tolerant of wetness. Slopes range from 0 to 5 percent.

Colo soils commonly are adjacent to Ely and Nodaway soils. The adjacent soils are in positions on the landscape similar to those of the Colo soils. Ely soils are somewhat poorly drained and have a grayish brown and brown B horizon at a depth of about 35 inches. Nodaway soils are lighter colored and less clayey than the Colo soils and are finely stratified.

Typical pedon of Colo silty clay loam, 0 to 2 percent slopes, about 2,500 feet south of 1,040 feet east of the northwest corner of sec. 15, T. 71 N., R. 19 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to moderate fine granular; friable; few very fine sand grains; neutral; abrupt smooth boundary.

A1—7 to 13 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to moderate fine granular; firm; few very fine sand grains; neutral; gradual smooth boundary.
A2—13 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine and fine subangular blocky structure; firm; few very fine sand grains; neutral; gradual smooth boundary.
A3—20 to 27 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; few very fine sand grains; neutral; gradual smooth boundary.
A4—27 to 36 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine prismatic structure parting to moderate very fine subangular blocky; firm; few very fine sand grains; neutral; gradual smooth boundary.
AC—36 to 48 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; dark gray (10YR 4/1) coatings on faces of prisms; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to weak very fine subangular blocky; firm; common dark concretions (iron and manganese oxides); few fine and very fine sand grains; neutral; diffuse wavy boundary.
Cg—48 to 60 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct brown (10YR 4/3) mottles; massive; firm; few fine and very fine sand grains; neutral.

The solum ranges from 36 to 50 inches in thickness. Some pedons have received 6 to 18 inches of stratified overwash sediments. This overwash has hue of 10YR, value of 3 to 5, and chroma of 1 or 2. It is silty clay loam or silt loam.

The A horizon has hue of 10YR, 5Y, or N, value of 2 or 3, and chroma of 0 or 1. The content of clay is 30 to 35 percent in the part of this horizon below a depth of 10 inches. It is 36 to 40 percent directly below the A horizon in some pedons where the 10- to 40-inch control section averages less than 35 percent clay.

Douds Series

The Douds series consists of moderately well drained, moderately permeable soils on the convex tops of low ridges and on the sides of high terraces that border the major streams and rivers. These soils formed in stratified alluvium. The native vegetation was deciduous trees. Slopes range from 9 to 18 percent.

Douds soils are similar to Galland soils and commonly are adjacent to Gara and Lindley soils. The Bt horizon of Galland soils has a redder matrix than that of the Douds soils and contains more clay. Gara and Lindley soils do not have a stratified solum. They are on side slopes and nose slopes and are higher on the landscape than the Douds soils.

Typical pedon of Douds loam, 9 to 14 percent slopes, moderately eroded, about 1,040 feet east and 120 feet north of the center of sec. 20, T. 73 N., R. 9 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; moderate fine granular structure; friable; strongly acid; abrupt smooth boundary.
Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) and brownish yellow (10YR 6/8) loam; weak fine subangular blocky structure; friable; thin discontinuous clay films and silt coatings; strongly acid; gradual smooth boundary.
Bt2—13 to 21 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) loam; moderate fine subangular blocky structure; friable; thin discontinuous clay films and silt coatings; strongly acid; gradual smooth boundary.
Bt3—21 to 28 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) sandy clay loam; weak fine subangular blocky structure; friable; thin discontinuous clay films and silt coatings; strongly acid; gradual smooth boundary.
Bt4—28 to 35 inches; yellowish brown (10YR 5/6) sandy clay loam that has lenses of sandy loam and very pale brown (10YR 7/3) sand; weak fine subangular blocky structure; friable; thin discontinuous clay films; strongly acid; gradual smooth boundary.
Bt5—35 to 43 inches; dark yellowish brown (10YR 4/4 and 4/6) and yellowish brown (10YR 5/6) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.
Bt6—43 to 50 inches; yellowish brown (10YR 5/4) and light brownish gray (2.5Y 6/2) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.
Bt7—50 to 60 inches; yellowish brown (10YR 5/4) clay loam; few thin lenses of sandy loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films; few concretions (iron and manganese oxides); strongly acid.

The solum ranges from 42 to 72 inches in thickness. The thickness of the solum and the depth to stratified material decrease as slope increases.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silt loam that has a noticeable content of sand. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8 in the upper part. It is loam, clay loam, or sandy clay loam. Strata of loam, sandy loam, or loamy sand are common in lower part of the B horizon and in the C horizon. The

content of clay in the upper 20 inches of the argillic horizon is 20 to 32 percent.

Edina Series

The Edina series consists of poorly drained, very slowly permeable soils on upland divides. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes are 0 to 1 percent.

Edina soils commonly are adjacent to Grundy and Haig soils. The adjacent soils are slightly higher on the landscape than the Edina soils. They do not have an E horizon.

Typical pedon of Edina silt loam, 0 to 1 percent slopes, about 1,650 feet north and 265 feet east of the southwest corner of sec. 31, T. 71 N., R. 17 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure parting to weak very fine platy; very friable; neutral; abrupt smooth boundary.

E—9 to 17 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 7/1) dry; weak fine platy structure; very friable; neutral; abrupt smooth boundary.

Bt1—17 to 20 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; common fine prominent dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm; thin discontinuous clay films; slightly acid; abrupt smooth boundary.

Bt2—20 to 29 inches; very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

Bt3—29 to 41 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct dark yellowish brown (10YR 4/4 and 4/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films; common dark concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

Bt4—41 to 48 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common coarse prominent strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; very firm; few fine pores; thin discontinuous clay films; common fine dark accumulations (iron and manganese oxides); slightly acid; clear smooth boundary.

C—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; massive; very firm; few fine pores; common dark concretions (iron and manganese oxides); neutral.

The thickness of the solum ranges from 40 to 60 inches. The A or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The upper part of the Bt horizon has hue of 2.5Y or 10YR, value of 2 or 3, and chroma of 1. The lower part has hue of 2.5Y, 10YR, or 5Y, value of 3 to 5, and chroma of 1 or 2. The maximum clay content in the Bt horizon is 45 to 55 percent.

Ely Series

The Ely series consists of somewhat poorly drained, moderately permeable soils on slightly concave foot slopes and alluvial fans. These soils formed in silty alluvium and colluvium. The native vegetation was tall prairie grasses. Slopes range from 2 to 5 percent.

Ely soils are similar to Lawson soils and commonly are adjacent to Clarinda, Colo, and Otley soils. Lawson soils contain less clay than the Ely soils, have horizons that are more weakly expressed, and are stratified in the control section. Clarinda and Otley soils are higher on the landscape than the Ely soils. Also, Clarinda soils contain more clay, and Otley soils have a thinner A horizon and are moderately well drained. Colo soils are downslope from the Ely soils and are poorly drained.

Typical pedon of Ely silty clay loam, 2 to 5 percent slopes, about 920 feet south and 280 feet west of the northeast corner of sec. 6, T. 73 N., R. 16 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to moderate fine granular; friable; neutral; abrupt smooth boundary.

A1—6 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; dark brown (10YR 3/3) coatings on peds; weak very fine subangular blocky structure parting to moderate fine granular; friable; neutral; gradual smooth boundary.

A2—16 to 25 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 4/4) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

BA—25 to 31 inches; very dark grayish brown (10YR 3/2) silty clay loam; very dark gray (10YR 3/1) coatings on peds; many fine distinct yellowish brown (10YR 5/6) and few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

Bw1—31 to 41 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam; many fine faint yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; friable; neutral; gradual smooth boundary.

Bw2—41 to 47 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) silty clay loam; few fine faint gray (10YR 5/1), common fine faint yellowish brown (10YR 5/6), and common fine distinct yellowish red (5YR 5/8) mottles; weak fine prismatic structure parting to weak fine subangular blocky; friable; neutral; gradual smooth boundary.

BC—47 to 60 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral.

The thickness of the solum ranges from 40 to 66 inches. The content of sand, mostly very fine and fine sand, is 5 to 20 percent throughout the solum. Colors with value of 3 or less extend to a depth of 24 to 36 inches. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The content of clay in the Bw horizon is 30 to 35 percent.

Galland Series

The Galland series consists of moderately well drained or somewhat poorly drained, slowly permeable soils on the convex tops of low ridges and on the sides of high terraces that border stream valleys. These soils formed in stratified alluvium. The native vegetation was deciduous trees. Slopes range from 5 to 14 percent.

Galland soils are similar to Douds and Lineville soils and commonly are adjacent to Gara and Lindley soils. Douds soils contain more sand and less clay than the Galland soils and do not have hue of 7.5YR or redder in the B horizon. Lineville soils average less than 35 percent clay in the upper part of the argillic horizon, commonly are deeper to the horizon that has the highest content of clay than the Galland soils, and are less stratified in the C horizon. Gara and Lindley soils are not stratified and formed in glacial till. They are on convex upland nose slopes or valley side slopes.

Typical pedon of Galland loam, 9 to 14 percent slopes, moderately eroded, about 2,300 feet south and 1,200 feet east of the northwest corner of sec. 8, T. 71 N., R. 16 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, pale brown (10YR 6/3) dry; mixed with some streaks and pockets of brown (10YR 4/3) clay loam subsoil material; weak very fine subangular blocky structure parting to moderate very fine subangular blocky; friable; medium acid; abrupt smooth boundary.

BE—5 to 8 inches; brown (10YR 4/3) clay loam; moderate very fine subangular blocky structure; firm; strongly acid; clear smooth boundary.

Bt1—8 to 13 inches; yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) clay loam; brown (10YR 4/3) coatings on faces of peds; few fine distinct reddish brown (5YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; moderate fine and very fine subangular blocky structure; firm; thin discontinuous clay films; strongly acid; clear smooth boundary.

Bt2—13 to 22 inches; strong brown (7.5YR 4/6) and yellowish brown (10YR 5/6) clay loam; dark yellowish brown (10YR 4/6) coatings on faces of peds; few fine prominent dark red (2.5YR 3/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous dark grayish brown (10YR 4/2) clay films; strongly acid; abrupt smooth boundary.

Bt3—22 to 32 inches; yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) clay loam; few fine faint grayish brown (10YR 5/2) and common fine distinct dark red (2.5YR 3/6) mottles; moderate fine subangular blocky structure; firm; thick continuous clay films; strongly acid; clear smooth boundary.

Bt4—32 to 43 inches; yellowish brown (10YR 5/6 and 5/8) clay loam; few fine faint light brownish gray (10YR 6/2) and common fine distinct yellowish red (5YR 4/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous dark grayish brown (10YR 4/2) clay films; strongly acid; abrupt smooth boundary.

C—43 to 60 inches; brown (7.5YR 4/4) and yellowish brown (10YR 5/6 and 5/8) sandy clay loam; few fine faint pale brown (10YR 6/3) mottles; massive; friable; strongly acid.

The thickness of the solum ranges from 36 to 72 inches. The A horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or dark grayish brown (10YR 4/2). The Bt horizon varies in texture but has a maximum clay content centered on clay loam, clay, or silty clay. It has hue of 10YR, 7.5YR, or 5YR, value of 3 to 6, and chroma of 2 to 8. In part of this horizon, the matrix or the many distinct or prominent mottles have hue of 7.5YR or redder. Moderately coarse textured to fine textured sediments high in content of quartz are common in the lower part of the B horizon, below a depth of 3 or 4 feet.

Gara Series

The Gara series consists of moderately well drained or well drained, moderately slowly permeable soils on convex nose slopes and side slopes in the uplands. These soils formed in glacial till. The native vegetation was mixed grasses and deciduous trees. Slopes range from 9 to 25 percent.

Gara soils are similar to Lindley soils and commonly are adjacent to Armstrong, Keswick, Lindley, and Pershing soils. Armstrong and Keswick soils formed partly or entirely in a paleosol high in content of clay.

They are upslope from the Gara soils. Lindley soils are in positions on the landscape similar to those of the Gara soils. Their surface layer is thinner and lighter colored than that of the Gara soils. Pershing soils formed in loess and contain more clay in the B horizon than the Gara soils. Also, they are higher on the landscape.

Typical pedon of Gara loam, 18 to 25 percent slopes, about 1,600 feet south and 800 feet east of the northwest corner of sec. 21, T. 71 N., R. 16 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

E—6 to 11 inches; dark grayish brown (10YR 4/2) clay loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak and moderate fine subangular blocky; firm; slightly acid; clear smooth boundary.

Bt1—11 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; thin discontinuous clay films and silt coatings; medium acid; gradual smooth boundary.

Bt2—18 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thin discontinuous clay films and silt coatings; few pebbles; medium acid; gradual smooth boundary.

Bt3—25 to 34 inches; yellowish brown (10YR 5/4) clay loam; few fine faint strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films and silt coatings; few dark concretions (iron and manganese oxides); few pebbles; medium acid; gradual smooth boundary.

Bt4—34 to 47 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; few fine and medium distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films and silt coatings; few pebbles; medium acid; gradual smooth boundary.

C1—47 to 51 inches; mottled yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few pebbles; mildly alkaline; gradual smooth boundary.

C2—51 to 60 inches; mottled yellowish brown (10YR 5/4 and 5/6) and grayish brown (2.5Y 5/2) clay loam; massive; firm; few pebbles; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 70 inches. The thickness of the A and Bt horizons, the depth to the maximum content of clay, the maximum content of clay in the Bt horizon, and the depth to carbonates decrease as slope increases.

The A or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is loam, silt loam, or clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in this horizon is 32 to 35 percent. The C horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 6.

The moderately eroded Gara soils in this county are taxadjuncts to the series because they have a thinner dark surface layer than is definitive for the series.

Gosport Series

The Gosport series consists of moderately deep, moderately well drained, very slowly permeable soils on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. These soils formed in a thin silty mantle and in the underlying material weathered from acid Pennsylvanian shale. The native vegetation was trees. Slopes range from 9 to 25 percent.

Gosport soils commonly are adjacent to Clinton, Gara, Keswick, Ladoga, Lindley, and Weller soils. The adjacent soils are in upslope areas on the summits of interfluves and on side slopes. Clinton, Ladoga, and Weller soils formed in loess. Gara, Keswick, and Lindley soils formed in glacial till.

Typical pedon of Gosport silt loam, 18 to 25 percent slopes, about 860 feet north and 1,620 feet east of the center of sec. 5, T. 73 N., R. 16 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; strongly acid; clear smooth boundary.

E—4 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine platy structure; friable; strongly acid; clear smooth boundary.

2BE—9 to 12 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silty clay; weak fine subangular blocky structure; very firm; common hard shale fragments 2 to 5 millimeters thick; strongly acid; gradual smooth boundary.

2Bw1—12 to 16 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) silty clay; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine and medium angular blocky structure; extremely firm; strongly acid; gradual smooth boundary.

2Bw2—16 to 20 inches; light olive brown (2.5Y 5/4) silty clay; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium angular blocky structure; extremely firm; strongly acid; gradual smooth boundary.

2BC—20 to 30 inches; light brownish gray (2.5Y 6/2) silty clay; few medium distinct yellowish brown

(10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; extremely firm; few hard shale fragments 2 to 5 millimeters thick; medium acid; gradual smooth boundary.

2Cr—30 to 60 inches; light brownish gray (2.5Y 6/2) clay shale; few medium distinct yellowish brown (10YR 5/6) mottles; weak medium platy rock structure; extremely firm; medium acid.

The thickness of the solum, or the depth to bedrock, ranges from 20 to 40 inches. The depth to material weathered mainly from shale typically is less than 15 inches. The Bw horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. It is silty clay or clay. The content of clay in the 10- to 40-inch control section ranges from 36 to 58 percent. The color of the Cr horizon varies widely.

Grundy Series

The Grundy series consists of somewhat poorly drained, slowly permeable soils on the convex tops of upland ridges. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 2 to 5 percent.

Grundy soils are similar to Arispe soils and commonly are adjacent to Adair, Haig, and Lamoni soils. The upper 20 inches of the argillic horizon in Arispe soils averages less than 42 percent clay. Adair and Lamoni soils are downslope from the Grundy soils. In their solum the content of sand coarser than very fine sand is more than 10 percent. Haig soils are in the less sloping areas and are poorly drained.

Typical pedon of Grundy silty clay loam, 2 to 5 percent slopes, about 485 feet south and 500 feet east of the northwest corner of sec. 18, T. 71 N., R. 19 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A—9 to 12 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

BA—12 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; medium acid; clear smooth boundary.

Bt1—16 to 23 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm; thin discontinuous clay films; medium acid; clear smooth boundary.

Bt2—23 to 31 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; common dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

Bt3—31 to 42 inches; grayish brown (10YR 5/2) silty clay; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt4—42 to 53 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; common dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

C—53 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; massive; firm; neutral.

The thickness of the solum ranges from 40 to about 72 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam. The upper part of the Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 to 3. The lower part has hue of 10YR to 5Y, value of 4 or 5, and chroma of 2 to 6. The content of clay in the upper 20 inches of the argillic horizon is 42 to 48 percent. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2.

Haig Series

The Haig series consists of poorly drained, very slowly permeable soils on upland divides. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Haig soils are similar to Taintor soils and commonly are adjacent to Edina and Grundy soils. Edina soils are in positions on the landscape similar to those of the Haig soils. They have an albic horizon. Their content of clay abruptly increases from the albic horizon to the argillic horizon. Grundy soils are somewhat poorly drained and are in the more sloping areas. Taintor soils contain less clay than the Haig soils and have a thinner Bt horizon.

Typical pedon of Haig silty clay loam, 0 to 2 percent slopes, about 500 feet south and 1,060 feet west of the northeast corner of sec. 33, T. 71 N., R. 19 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A1—7 to 11 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; neutral; clear smooth boundary.
A2—11 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure parting to weak fine granular; friable; slightly acid; gradual smooth boundary.
Bt—17 to 23 inches; very dark gray (10YR 3/1) silty clay; few fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; thick discontinuous clay films; slightly acid; gradual smooth boundary.
Btg1—23 to 34 inches; dark gray (5Y 4/1) silty clay; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; thick continuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Btg2—34 to 41 inches; gray (5Y 5/1) silty clay; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thick continuous clay films on faces of prisms; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth bouundary.
Btg3—41 to 51 inches; olive gray (5Y 5/2) silty clay loam; some dark gray (10YR 4/1) faces of prisms; many medium distinct brown (7.5YR 5/4) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; thick continuous clay films on faces of prisms; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.
Btg4—51 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium distinct brown (7.5YR 5/4) and strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; friable; thin discontinuous clay films on faces of prisms; few dark concretions (iron and manganese oxides); neutral.

The thickness of the solum ranges from 48 to more than 60 inches. The mollic epipedon is 20 to 24 inches thick.

The A horizon is black (10YR 2/1) or very dark gray (10YR 3/1). It typically is silty clay loam but in some pedons is silt loam. The B horizon has hue of 10YR to 5Y. It has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 in the lower part. The clay content in the upper 20 inches of the argillic horizon is 42 to 48 percent.

Keswick Series

The Keswick series consists of moderately well drained, slowly permeable soils on convex interfluves, side slopes, and nose slopes in the uplands. These soils formed in a paleosol weathered from glacial till. The native vegetation was trees. Slopes range from 5 to 14 percent.

Keswick soils are similar to Lineville soils and commonly are adjacent to Armstrong, Lindley, and Weller soils. Lineville soils average less than 35 percent clay in the upper part of the argillic horizon. They commonly are deeper to the horizon having the highest content of clay than the Keswick soils. Armstrong soils are in positions on the landscape similar to those of the Keswick soils. Their A horizon is thicker than that of the Keswick soils. Lindley soils are less red than the Keswick soils and contain less clay in the Bt horizon. Also, they are lower on the landscape. Weller soils are higher on the landscape than the Keswick soils. Also, their solum contains less sand throughout.

Typical pedon of Keswick loam, 5 to 9 percent slopes, about 900 feet east and 660 feet north of the southwest corner of sec. 5, T. 71 N., R. 19 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; few fine roots; strongly acid; abrupt smooth boundary.
E—5 to 10 inches; brown (10YR 5/3) loam, light gray (10YR 7/2) dry; moderate fine platy structure parting to weak fine granular; friable; strongly acid; clear smooth boundary.
BE—10 to 13 inches; brown (10YR 4/3) clay loam; few medium distinct strong brown (7.5YR 4/6) and brown (7.5YR 5/2) mottles; moderate fine subangular blocky structure; firm; thin pebble band at the base of the horizon; strongly acid; gradual smooth boundary.
2Bt1—13 to 19 inches; yellowish red (5YR 4/6) and brown (7.5YR 5/4) clay; few fine distinct brown (7.5YR 5/2) mottles; moderate very fine and fine subangular blocky structure; firm; thin discontinuous clay films and silt coatings; strongly acid; clear smooth boundary.
2Bt2—19 to 25 inches; yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) clay loam; moderate very fine and fine subangular blocky structure; firm; thick discontinuous clay films; strongly acid; gradual smooth boundary.
2Bt3—25 to 32 inches; strong brown (7.5YR 5/6 and 5/8) clay loam; few fine faint yellowish red (5YR 4/6) mottles; moderate fine prismatic structure parting to moderate medium subangular blocky; firm; thick discontinuous clay films; strongly acid; clear smooth boundary.
2Bt4—32 to 39 inches; mottled strong brown (7.5YR 5/6), brown (7.5YR 5/4), and grayish brown (10YR 5/2) clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; strongly acid; gradual smooth boundary.

2Bt5—39 to 48 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; few fine faint olive gray (5Y 5/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; strongly acid; gradual smooth boundary.
2BC—48 to 60 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; few fine faint gray (5Y 6/1) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; medium acid.

The solum ranges from 42 to 72 inches in thickness. The thickness of the A horizon, the depth to the maximum content of clay, the thickness of the reddish 2Bt horizon, and the depth to carbonates decrease as the slope increases.

The A horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2). The E horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). The 2Bt horizon is firm clay loam or clay in which the content of clay is 35 to 48 percent. The upper part of this horizon commonly has hue of 5YR or 7.5YR, value 4 or 5, and chroma of 3 to 6. The lower part of the 2Bt horizon and the 2BC horizon have hue of 10YR, value of 4 or 5, and chroma of 4 to 6.

Koszta Series

The Koszta series consists of somewhat poorly drained, moderately permeable soils on low stream terraces and high second bottoms. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Koszta soils commonly are adjacent to Colo, Lawson, Okaw, and Zook soils. Colo, Lawson, and Zook soils are lower on the landscape than the Koszta soils and have a thicker mollic epipedon. Also, Colo and Zook soils are poorly drained. Okaw soils have a higher content of clay than the Koszta soils and have a lower chroma in the B horizon. Their positions on the landscape are similar to those of the Koszta soils.

Typical pedon of Koszta silt loam, 0 to 2 percent slopes, about 530 feet north and 2,245 feet east of the center of sec. 12, T. 73 N., R. 16 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.
E—7 to 14 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine platy structure parting to moderate fine granular; friable; neutral; clear smooth boundary.
BE—14 to 20 inches; brown (10YR 4/3) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) mottles; moderate very fine subangular blocky structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.
Bt1—20 to 25 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Bt2—25 to 31 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate fine and very fine subangular blocky; firm; thin discontinuous grayish brown (10YR 5/2) clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Bt3—31 to 39 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay loam; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; thin discontinuous grayish brown (10YR 5/2) clay films; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Bt4—39 to 51 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous grayish brown (10YR 5/2) clay films; common dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.
C—51 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay loam; massive; firm; common dark concretions (iron and manganese oxides); slightly acid.

The thickness of the solum ranges from 36 to 60 inches. The A or Ap horizon is black (10YR 2/1), very dark grayish brown (10YR 2/2), or very dark gray (10YR 3/1). The E horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The upper part of the Bt horizon dominantly has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The content of clay in the Bt horizon is 28 to 35 percent.

Ladoga Series

The Ladoga series consists of moderately well drained, moderately slowly permeable soils on the convex tops of ridges and the upper parts of side slopes on uplands and high stream benches. These soils formed in loess. The native vegetation was deciduous trees and tall prairie grasses. Slopes range from 2 to 14 percent.

Ladoga soils are similar to Clinton soils and commonly are adjacent to Clinton and Gosport soils. Clinton soils are in positions on the landscape similar to those of the Ladoga soils. Their A horizon is thinner and lighter colored than that of the Ladoga soils, and their E horizon

is thicker and more distinct. Gosport soils are downslope from the Ladoga soils. They are about 15 inches deep to material that weathered mainly from shale.

Typical pedon of Ladoga silt loam, 5 to 9 percent slopes, about 660 feet north and 1,700 feet east of the southwest corner of sec. 1, T. 73 N., R. 16 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.
BE—8 to 12 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; very dark grayish brown (10YR 3/2) fillings in root channels; slightly acid; clear smooth boundary.
Bt1—12 to 18 inches; brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; few discontinuous dark grayish brown (10YR 4/2) silt coatings; medium acid; gradual smooth boundary.
Bt2—18 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; thin continuous clay films; few discontinuous dark grayish brown (10YR 4/2) silt coatings; medium acid; gradual smooth boundary.
Bt3—25 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films; few discontinuous dark grayish brown (10YR 4/2) silt coatings; medium acid; gradual smooth boundary.
Bt4—31 to 43 inches; brown (10YR 5/3) silty clay loam; few fine distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few discontinuous dark grayish brown (10YR 4/2) silt coatings; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Bt5—43 to 50 inches; brown (10YR 5/3) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few discontinuous dark grayish brown (10YR 4/2) silt coatings; slightly acid; gradual smooth boundary.
C—50 to 60 inches; brown (10YR 5/3) silt loam; common medium distinct dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; massive; slightly acid.

The thickness of the solum ranges from 36 to 72 inches. The thickness of the A and Bt horizons, the depth to the horizon having the maximum content of clay, the maximum content of clay, and the depth to grayish mottles decrease with increasing slope.

The A or Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The content of clay in the Bt horizon is 36 to 42 percent. In some pedons the matrix color is olive gray below a depth of 36 inches.

The moderately eroded Ladoga soils in this county are taxadjuncts to the series because they have a thinner dark surface layer than is definitive for the series.

Lamoni Series

The Lamoni series consists of somewhat poorly drained, slowly permeable soils on convex side slopes in the uplands. These soils formed in a partly truncated, clayey paleosol weathered from glacial till. The native vegatation was tall prairie grasses. Slopes range from 9 to 14 percent.

These soils are taxadjuncts to the Lamoni series because they lack a mollic epipedon.

Lamoni soils are similar to Adair and Clarinda soils and commonly are adjacent to Adair, Arispe, Grundy, and Mahaska soils. Adair soils do not have mottles with chroma of 2 in the lower part of the B horizon or in the C horizon and have hue of 7.5YR or redder in the upper part of the Bt horizon. Their positions on the landscape are similar to those of the Lamoni soils. Clarinda soils contain more clay in the lower part of the Bt horizon than the Lamoni soils. Arispe, Grundy, and Mahaska soils do not have pebbles in the upper 36 inches of the solum and contain less sand than the Lamoni soils. Also, they are higher on the landscape.

Typical pedon of Lamoni clay loam, 9 to 14 percent slopes, moderately eroded, about 640 feet north and 300 feet east of the southwest corner of sec. 30, T. 71 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; mixed with some streaks and pockets of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) subsoil material; moderate fine granular structure; firm; few fibrous roots; neutral; abrupt smooth boundary.
2BA—7 to 14 inches; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) clay loam; moderate very fine subangular blocky structure; firm; few fibrous roots; slightly acid; gradual smooth boundary.
2Bt1—14 to 24 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4 and 5/6) clay; weak medium prismatic structure parting to moderate fine subangular blocky; very firm; thin discontinuous clay films; common dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.
2Bt2—24 to 33 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4 and 5/6) clay;

moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; thin discontinuous clay films; few small pebbles; slightly acid; gradual smooth boundary.

2Bt3—33 to 46 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) clay loam; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very firm; thin discontinuous clay films; few small pebbles; slightly acid; gradual smooth boundary.

2Bt4—46 to 60 inches; mottled light brownish gray (2.5Y 6/2), light olive gray (5Y 6/2), and yellowish brown (10YR 5/6) clay loam; weak medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few small pebbles; neutral.

The thickness of the solum ranges from 48 to 72 inches. The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It typically is clay loam, but the range includes loam and silty clay loam. The upper part of the 2Bt horizon generally has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4 and has mottles with higher chroma. The lower part generally is mottled and has hue of 10YR to 5Y, value of 5 or 6, and chroma of 2 to 6. Only the mottles or oxides have hue redder than 10YR.

Lawson Series

The Lawson series consists of somewhat poorly drained, moderately permeable soils on first and second bottoms near the major streams and in old oxbows on outwash plains. These soils formed in alluvium. The native vegetation was prairie grasses and scattered trees. Slopes range from 0 to 2 percent.

Lawson soils are similar to Ely soils and commonly are adjacent to Colo and Nodaway soils. The adjacent soils are in positions on the landscape similar to those of the Lawson soils. Colo soils are poorly drained. Nodaway soils are more stratified than the Lawson soils and have a thinner A horizon. Ely soils have a cambic horizon with chroma of 3 directly below the mollic epipedon. They are on the more sloping foot slopes and alluvial fans.

Typical pedon of Lawson silt loam, 0 to 2 percent slopes, about 300 feet south and 2,200 feet east of the northwest corner of sec. 10, T. 73 N., R. 16 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; few fibrous roots; slightly acid; clear smooth boundary.

A1—9 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate medium granular; friable; few fibrous roots; neutral; gradual smooth boundary.

A2—22 to 35 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fibrous roots; slightly acid; gradual smooth boundary.

C—35 to 44 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; massive; firm; few fibrous roots; slightly acid; gradual smooth boundary.

Cg—44 to 60 inches; dark grayish brown (10YR 4/2) silt loam that has thin lenses of loam and sandy loam; common fine faint brown (10YR 5/3) mottles; massive; friable; few fibrous roots; slightly acid.

The content of clay in the control section ranges from 18 to 30 percent. Strata containing more sand are common below a depth of 40 inches. Reaction is slightly acid to mildly alkaline throughout the profile. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 6.

Lindley Series

The Lindley series consists of well drained, moderately slowly permeable soils on valley side slopes and convex upland nose slopes. These soils formed in glacial till. The native vegetation was deciduous trees. Slopes range from 9 to 40 percent.

Lindley soils are similar to Gara soils and commonly are adjacent to Armstrong, Gara, and Keswick soils. Armstrong and Keswick soils are upslope from the Lindley soils. In the upper part of their argillic horizon, the content of clay is more than 35 percent and either the matrix or the mottles have hue as red as 5YR. Gara soils are in positions on the landscape similar to those of the Lindley soils. Their surface layer is thicker and darker than that of the Lindley soils.

Typical pedon of Lindley loam, 18 to 40 percent slopes, about 1,880 feet south and 20 feet west of the northeast corner of sec. 19, T. 73 N., R. 19 W.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine granular structure; friable; few fibrous roots; very strongly acid; abrupt smooth boundary.

E—4 to 9 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; weak medium platy structure parting to moderate fine and very fine granular; friable; few fibrous roots; very strongly acid; abrupt smooth boundary.

BE—9 to 15 inches; yellowish brown (10YR 5/4) clay loam; moderate very fine and fine subangular blocky structure; firm; few fibrous roots; very strongly acid; clear smooth boundary.

Bt1—15 to 28 inches; yellowish brown (10YR 5/6) clay loam; moderate fine subangular blocky structure;

firm; few fibrous roots; thin discontinuous clay films; very strongly acid; clear smooth boundary.
Bt2—28 to 35 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fibrous roots; thin discontinuous clay films; very strongly acid; gradual smooth boundary.
Bt3—35 to 44 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fibrous roots; thin discontinuous clay films; very strongly acid; gradual smooth boundary.
Bt4—44 to 50 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fibrous roots; thin discontinuous clay films; very strongly acid; gradual smooth boundary.
C—50 to 60 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) clay loam; moderate medium prismatic structure; firm; few fibrous roots; thin discontinuous clay films; strongly acid.

The thickness of the solum ranges from 30 to about 50 inches. The A horizon has hue of 10YR, value of 3 or 4, and chroma of 1 or 2. It typically is loam but in some pedons is silt loam or clay loam. The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma commonly of 4 to 6. The content of clay in this horizon ranges from 25 to 35 percent. The C horizon is yellowish brown (10YR 5/6) or strong brown (7.5YR 5/6) and commonly is mottled with light brownish gray (10YR 6/2).

Lineville Series

The Lineville series consists of somewhat poorly drained, slowly permeable soils on short, convex side slopes, narrow, convex ridgetops, and convex nose slopes in the uplands. These soils formed in 10 to 20 inches of loess and in the underlying erosional sediments and glacial till. The native vegetation was prairie grasses and trees. Slopes range from 5 to 9 percent.

Lineville soils are similar to Armstrong, Galland, and Keswick soils and commonly are adjacent to Adair, Armstrong, Gara, and Pershing soils. Adair and Armstrong soils are lower on the landscape than the Lineville soils. Also, they are shallower to reddish, clayey till. Galland soils contain more clay in the upper part of the argillic horizon than the Lineville soils and are more stratified in the C horizon. Gara soils are downslope from the Lineville soils. They formed entirely in glacial till that does not have a reddish hue. Keswick soils contain more clay in the upper part of the Bt horizon than the Lineville soils. Pershing soils formed entirely in loess. They are upslope from the Lineville soils.

Typical pedon of Lineville silt loam, 5 to 9 percent slopes, about 1,240 feet south and 1,640 feet west of the northeast corner of sec. 22, T. 71 N., R. 18 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; medium acid; abrupt smooth boundary.
E—7 to 11 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
Bt1—11 to 14 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; thin discontinuous clay films and silt coatings; medium acid; gradual smooth boundary.
2Bt2—14 to 22 inches; brown (10YR 4/3) clay loam; few fine faint dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) mottles; moderate fine and medium subangular blocky structure; firm; thin discontinuous clay films and silt coatings; medium acid; gradual smooth boundary.
2Bt3—22 to 29 inches; grayish brown (10YR 5/2) and brown (10YR 4/3) clay loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; thin discontinuous clay films and silt coatings; medium acid; gradual smooth boundary.
2Bt4—29 to 35 inches; grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) clay loam; common fine distinct yellowish red (5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; thin discontinuous clay films and silt coatings; few pebbles; medium acid; gradual smooth boundary.
3Bt5—35 to 45 inches; mottled yellowish brown (10YR 5/4), brown (7.5YR 5/4), and yellowish red (5YR 4/6) clay loam; moderate fine and medium subangular blocky structure; firm; thin discontinuous clay films; few pebbles; medium acid; clear smooth boundary.
3Bt6—45 to 60 inches; strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) clay loam; weak medium subangular blocky structure; firm; common dark concretions (iron and manganese oxides); few pebbles; medium acid.

The solum is about 60 to 72 inches thick. It typically is medium acid or strongly acid in the most acid part.

The A or Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A and E horizons typically are silt loam but in some pedons are

loam. The content of clay in the upper 10 to 20 inches is about 18 to 27 percent, and the content of sand is 15 to 25 percent. The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The content of clay in this horizon ranges from 20 to 35 percent. The 3Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 2 to 6. The content of clay in the upper part of this horizon is 35 to 45 percent.

Mahaska Series

The Mahaska series consists of somewhat poorly drained, moderately permeable soils on upland divides. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Mahaska soils are similar to Arispe soils and commonly are adjacent to Otley and Taintor soils. Arispe soils are more sloping than the Mahaska soils. Also, they have a lower content of organic carbon, and the horizon in which their content of clay is highest is at a depth of 10 to 18 inches. Otley soils are moderately well drained and are downslope from the Mahaska soils. Taintor soils are poorly drained. Their positions on the landscape are similar to those of the Mahaska soils.

Typical pedon of Mahaska silty clay loam, 0 to 2 percent slopes, about 900 feet east and 80 feet south of the northwest corner of sec. 20, T. 73 N., R. 16 W.

Ap—0 to 7 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common fibrous roots; medium acid; gradual smooth boundary.

A1—7 to 14 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; common fibrous roots; medium acid; gradual smooth boundary.

A2—14 to 19 inches; very dark gray (10YR 3/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; few fibrous roots; medium acid; gradual smooth boundary.

BA—19 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; few fibrous roots; medium acid; gradual smooth boundary.

Bt1—24 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; few fibrous roots; thin discontinuous clay films; medium acid; gradual smooth boundary.

Bt2—30 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; few fibrous roots; thin discontinuous clay films; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt3—36 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; friable; few fibrous roots; thin discontinuous clay films; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt4—42 to 50 inches; olive gray (5Y 5/2) silty clay loam; some grayish brown (2.5Y 5/2) masses; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous clay films; dark grayish brown (10YR 4/2) root channels; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—50 to 60 inches; olive gray (5Y 5/2) silty clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; dark grayish brown (10YR 4/2) root channels; common dark concretions (iron and manganese oxides); slightly acid.

The thickness of the solum ranges from 48 to 72 inches. The mollic epipedon is 14 to 24 inches thick.

The A or Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The upper part of the Bt horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or 3. The lower part of the Bt horizon and the BC horizon have hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 or 3.

Nodaway Series

The Nodaway series consists of moderately well drained, moderately permeable soils on bottom land near stream channels. These soils formed in alluvium. The native vegetation was mixed grasses and deciduous trees. Slopes range from 0 to 2 percent.

Nodaway soils commonly are adjacent to Lawson soils. They are more stratified than Lawson soils and have a thinner A horizon. Their positions on the landscape are similar to those of Lawson soils.

Typical pedon of Nodaway silt loam, 0 to 2 percent slopes, about 1,100 feet north and 900 feet east of the center of sec. 7, T. 73 N., R. 16 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

C—7 to 60 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and grayish brown (10YR 5/2) silt loam; massive; thin platy fragments resulting from stratification; friable; slightly acid.

The Ap horizon is dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The C horizon is dominantly very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2). Some strata have hue of 10YR, value of 4 or 5, and chroma of 2 to 4. Dark, medium textured or moderately fine textured buried soils are below a depth of 36 inches in some pedons.

Okaw Series

The Okaw series consists of poorly drained, very slowly permeable soils on low terraces, mainly along the major streams. These soils formed in alluvium. The native vegetation was trees. Slopes range from 0 to 2 percent.

Okaw soils are similar to Beckwith soils and commonly are adjacent to Lawson and Nodaway soils. Beckwith soils contain less sand and less clay in the solum than the Okaw soils. Lawson and Nodaway soils contain less clay than the Okaw soils. Also, they are lower on the landscape.

Typical pedon of Okaw silt loam, 0 to 2 percent slopes, about 2,080 feet west and 340 feet north of the center of sec. 29, T. 73 N., R. 16 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

E—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 7/2) dry; weak medium platy structure parting to weak fine granular; friable; medium acid; clear smooth boundary.

2Btg1—14 to 23 inches; dark gray (10YR 4/1) silty clay; common fine faint yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; thin discontinuous clay films; thin discontinuous silt coatings; medium acid; gradual smooth boundary.

2Btg2—23 to 29 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay; very dark gray (10YR 3/1) coatings on peds; common fine faint yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous clay films; thin discontinuous silt coatings; strongly acid; gradual smooth boundary.

2Btg3—29 to 37 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay; very dark gray (10YR 3/1) coatings on peds; few fine faint yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; thick discontinuous clay films; thin discontinuous silt coatings; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

2Btg4—37 to 48 inches; dark gray (10YR 4/1) silty clay; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

2Btg5—48 to 60 inches; dark gray (10YR 4/1) silty clay loam; few fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous clay films; few dark root channels; few dark concretions (iron and manganese oxides); strongly acid.

The thickness of the solum ranges from 30 to 65 inches. The A or Ap horizon is very dark grayish brown (10YR 3/2) to light brownish gray (10YR 6/2). The 2Btg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6, and chroma of 2 or less. It is silty clay loam, silty clay, or clay. The content of clay in the upper 20 inches of the argillic horizon is 35 to 48 percent.

Olmitz Series

The Olmitz series consists of moderately well drained, moderately permeable soils on slightly concave foot slopes and alluvial fans. These soils formed in loamy local alluvium derived from glacial till. The native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Olmitz soils commonly are adjacent to Colo, Ely, Gara, and Shelby soils. Colo and Ely soils are more poorly drained than the Olmitz soils and contain less sand. Also, Colo soils are lower on the landscape. Ely soils are in positions on the landscape similar to those of the Olmitz soils. Gara and Shelby soils are higher on the landscape than the Olmitz soils. Also, they have a thinner A horizon, and they formed in glacial till, have a firmer B horizon and a higher bulk density, and contain some stones and pebbles throughout the solum.

Typical pedon of Olmitz loam, 5 to 9 percent slopes, about 240 feet south and 80 feet east of the center of sec. 20, T. 71 N., R. 18 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak medium granular; friable; few fibrous roots; slightly acid; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular

blocky structure; friable; few fibrous roots; slightly acid; clear smooth boundary.
A2—14 to 22 inches; very dark brown (10YR 2/2) clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; few fibrous roots; slightly acid; gradual smooth boundary.
A3—22 to 29 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; very dark gray (10YR 3/1) faces of peds; weak fine subangular blocky structure; friable; few fibrous roots; few pebbles at a depth of about 26 inches; medium acid; gradual smooth boundary.
BA—29 to 37 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fibrous roots; medium acid; gradual smooth boundary.
Bw—37 to 48 inches; brown (10YR 4/3) clay loam; very dark grayish brown (10YR 3/2) coatings on peds; weak fine subangular blocky structure; friable; few fibrous roots; few pebbles at a depth of about 40 inches; slightly acid; gradual smooth boundary.
BC—48 to 60 inches; brown (10YR 4/3) clay loam; dark grayish brown (10YR 4/2) coatings on faces of peds; weak medium subangular blocky structure; friable; slightly acid.

The thickness of the solum ranges from 36 to 65 inches. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It is loam or clay loam. The B horizon is dominantly clay loam in which the content of clay is 28 to 34 percent.

Otley Series

The Otley series consists of moderately well drained, moderately permeable soils on the convex tops of ridges and the upper parts of side slopes in the uplands. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 2 to 9 percent.

Otley soils commonly are adjacent to Ladoga, Mahaska, and Vanmeter soils. Ladoga soils are in positions on the landscape similar to those of the Otley soils. Their A horizon is thinner and lighter colored than that of the Otley soils. Mahaska soils are higher on the landscape than the Otley soils. Also, they have lower chroma mottles in the B horizon. Vanmeter soils are less than 15 inches deep to shale residuum. They are downslope from the Otley soils.

Typical pedon of Otley silty clay loam, 2 to 5 percent slopes, about 360 feet north and 320 feet west of the center of sec. 10, T. 73 N., R. 17 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; medium acid; abrupt smooth boundary.
A1—7 to 12 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to moderate fine granular; friable; strongly acid; clear smooth boundary.
A2—12 to 16 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure parting to weak fine granular; friable; strongly acid; abrupt smooth boundary.
Bt1—16 to 23 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; firm; thin discontinuous clay films; strongly acid; clear smooth boundary.
Bt2—23 to 29 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak very fine prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous clay films; strongly acid; clear smooth boundary.
Bt3—29 to 35 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay loam; weak very fine prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous clay films; medium acid; gradual smooth boundary.
Bt4—35 to 41 inches; mottled grayish brown (2.5Y 5/2) and light brownish gray (10YR 6/2) silty clay loam; few fine distinct yellowish brown (10YR 5/8) mottles; weak fine prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.
Bt5—41 to 48 inches; light brownish gray (2.5Y 6/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous clay films; neutral; gradual smooth boundary.
C—48 to 60 inches; light brownish gray (10YR 6/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; massive; some vertical cleavage; firm; neutral.

The thickness of the solum ranges from 48 to 72 inches. The thickness of the A and Bt horizons, the depth to the horizon having the highest content of clay, the maximum content of clay, and the depth to gray mottles decrease as the slope increases.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). The upper part of the Bt horizon is brown (10YR 4/3), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). The lower part has hue of 10YR or 2.5Y, value of 4 to 6, and chroma dominantly of 2 to 4.

Otley silty clay loam, 5 to 9 percent slopes, moderately eroded, is a taxadjunct to the series because it lacks a mollic epipedon.

Pershing Series

The Pershing series consists of moderately well drained or somewhat poorly drained, slowly permeable soils on convex upland slopes and on stream benches. These soils formed in loess. The native vegetation was mixed grasses and deciduous trees. Slopes range from 2 to 14 percent.

Pershing soils are similar to Weller soils and commonly are adjacent to Rinda soils. The A horizon of Weller soils is thinner than that of the Pershing soils, and the E horizon is thicker. Rinda soils contain more clay in the B horizon than the Pershing soils. Also, they contain more sand in the lower part of the B horizon and in the C horizon. They are on side slopes and in coves at the head of drainageways in the uplands.

Typical pedon of Pershing silt loam, 2 to 5 percent slopes, about 80 feet west and 2,100 feet south of the northeast corner of sec. 6, T. 72 N., R. 18 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common dark concretions (iron and manganese oxides); neutral; abrupt smooth boundary.

E—6 to 9 inches; dark grayish brown (2.5Y 4/2) silt loam, grayish brown (2.5Y 5/2) dry; very dark grayish brown (2.5Y 3/2) faces of peds; common fine distinct light olive brown (2.5Y 5/4) mottles; weak medium platy structure; friable; common dark concretions (iron and manganese oxides); medium acid; clear smooth boundary.

BE—9 to 13 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/4) silty clay loam; dark gray (10YR 4/1) coatings on faces of peds; weak very fine subangular blocky structure; friable; discontinuous silt coatings, light gray (10YR 7/1) dry; strongly acid; clear smooth boundary.

Bt1—13 to 17 inches; mottled yellowish brown (10YR 5/4) and grayish brown (2.5Y 5/2) silty clay; dark gray (10YR 4/1) and grayish brown (2.5Y 5/2) coatings on faces of peds; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; few thin patchy gray (10YR 6/1) silt coatings; few fine dark accumulations (iron and manganese oxides); strongly acid; clear smooth boundary.

Bt2—17 to 26 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay; strong fine subangular blocky structure; very firm; thick continuous clay films; few dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt3—26 to 37 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay; weak fine prismatic structure parting to moderate and strong fine subangular blocky; firm; thick continuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt4—37 to 46 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) silty clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine prismatic structure parting to weak fine subangular blocky; firm; thin discontinuous clay films; few dark gray (10YR 4/1) clay flows on faces of prisms; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Bt5—46 to 60 inches; mottled yellowish brown (10YR 5/6), gray (5Y 6/1), and grayish brown (2.5Y 5/2) silty clay loam; weak fine prismatic structure; friable; few dark gray (10YR 4/1) clay flows on faces of prisms; common dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

BC—60 to 72 inches; mottled yellowish brown (10YR 5/4) and gray (5Y 6/1) silty clay loam; weak medium prismatic structure; friable; few dark gray (10YR 4/1) clay films on faces of prisms; many dark concretions (iron and manganese oxides); medium acid.

The thickness of the solum ranges from 60 to 96 inches. The Ap or A horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is silt loam or silty clay loam. The E horizon typically is dark grayish brown (2.5Y 4/2) but in some pedons is grayish brown (2.5Y 5/2). The upper part of the Bt horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 to 4. The content of clay in the finest textured part of this horizon is 42 to 48 percent. In some pedons the lower part of the solum formed in a paleosol.

Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded, and Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded, are taxadjuncts to the series because they have a thinner dark surface layer than is definitive for the series.

Rinda Series

The Rinda series consists of poorly drained, very slowly permeable soils on convex side slopes and in coves at the head of drainageways in the uplands. These soils formed in a paleosol weathered from glacial till. The native vegetation was mixed grasses and deciduous trees. Slopes range from 5 to 14 percent.

These soils are taxadjuncts to the Rinda series because they have a thinner dark surface layer than is definitive for the series.

Rinda soils are similar to Ashgrove and Bucknell soils and commonly are adjacent to Pershing soils. The A horizon of Ashgrove soils is thinner than that of the Rinda soils, and the E horizon is more distinct. Bucknell soils contain less clay in the lower part of the Bt horizon than the Rinda soils. Pershing soils have a lower

maximum clay content in the Bt horizon than the Rinda soils and contain less sand in the lower part of the B horizon and in the C horizon. They are on convex upland slopes and on stream benches.

Typical pedon of Rinda silty clay loam, 5 to 9 percent slopes, moderately eroded, about 2,200 feet east and 140 feet north of the southwest corner of sec. 25, T. 71 N., R. 18 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; mixed with streaks and pockets of dark grayish brown (10YR 4/2) subsoil material; moderate fine granular structure; friable; thin discontinuous silt coatings; slightly acid; abrupt smooth boundary.

BE—7 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; friable; thin discontinuous silt coatings; medium acid; gradual smooth boundary.

2Bt1—11 to 19 inches; dark grayish brown (10YR 4/2) silty clay; few fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous clay films; strongly acid; gradual smooth boundary.

2Bt2—19 to 28 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; thick discontinuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

2Bt3—28 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine faint dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; thick discontinuous clay films; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

2Bt4—36 to 44 inches; mottled gray (10YR 5/1), dark grayish brown (2.5Y 4/2), and yellowish brown (10YR 5/6) silty clay; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; thick discontinuous clay films; few dark concretions (iron and manganese oxides); neutral; gradual smooth boundary.

2Bt5—44 to 60 inches; light gray (5Y 6/1) silty clay; common fine distinct yellowish brown (10YR 5/6) and few fine distinct yellowish red (5YR 5/8) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; thick discontinuous clay films; few dark concretions (iron and manganese oxides); neutral.

The solum typically is more than 60 inches thick. The upper 10 to 18 inches in most pedons formed in loess or silty sediments.

The A or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). Some pedons have an E horizon. This horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. It is silty clay loam or silty clay. The 2Bt horizon has hue of 10YR to 5Y and value of 4 to 6. It has chroma of 1 or 2 in the upper part and chroma of 1 to 6 in the lower part. The content of clay in the upper 30 inches of this horizon is about 45 to 55 percent.

Shelby Series

The Shelby series consists of moderately well drained or well drained, moderately slowly permeable soils on convex side slopes in the uplands. These soils formed in glacial till. The native vegetation was prairie grasses. Slopes range from 9 to 18 percent.

These soils are taxadjuncts to the Shelby series because they lack a mollic epipedon.

Shelby soils commonly are adjacent to Arispe, Clarinda, and Lamoni soils. The adjacent soils are upslope from the Shelby soils. Arispe soils formed in loess. The B horizon of Clarinda and Lamoni soils is finer textured than that of the Shelby soils and is grayish.

Typical pedon of Shelby clay loam, 9 to 14 percent slopes, moderately eroded, about 520 feet north and 600 feet west of the center of sec. 32, T. 71 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; mixed with streaks and pockets of dark yellowish brown (10YR 4/4) subsoil material; weak fine granular structure; friable; few fibrous roots; neutral; abrupt smooth boundary.

BA—7 to 11 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; firm; slightly acid; clear smooth boundary.

Bt1—11 to 16 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

Bt2—16 to 23 inches; dark yellowish brown (10YR 4/6) clay loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films; slightly acid; clear smooth boundary.

Bt3—23 to 32 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure parting to moderate medium subangular blocky; firm; thin discontinuous clay films; slightly acid; gradual smooth boundary.

Bt4—32 to 39 inches; yellowish brown (10YR 5/6) clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; thin

discontinuous clay films; many stones and pebbles; neutral; gradual smooth boundary.
C—39 to 60 inches; dark yellowish brown (10YR 4/6) clay loam; massive; firm; many stones and pebbles; slight effervescence; mildly alkaline.

The thickness of the solum typically is 35 to 50 inches but ranges from 30 to 75 inches. The thickness of the A and Bt horizons and of the solum, the depth to the horizon having the highest content of clay, and the depth to carbonates typically decrease with increasing slope.

The Ap or A horizon is black (10YR 2/1), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1). It is loam or clay loam. Some pedons have an AB horizon, which is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in this horizon typically is 32 to 35 percent. The A and B horizons are medium acid to neutral. The C horizon is neutral to mildly alkaline.

Sparta Series

The Sparta series consists of excessively drained, rapidly permeable soils on uplands and stream terraces. These soils formed in sandy material that has been reworked by wind. The native vegetation was mixed deciduous trees and prairie grasses. Slopes range from 5 to 14 percent.

Sparta soils commonly are adjacent to Pershing soils. The adjacent soils contain less sand than the Sparta soils and formed in silty loess. Their positions on the landscape are similar to those of the Sparta soils.

Typical pedon of Sparta loamy fine sand, 5 to 14 percent slopes, about 130 feet north and 1,920 feet west of the center of sec. 35, T. 73 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) and brown (10YR 5/3) dry; weak fine subangular blocky structure parting to single grained; very friable; neutral; gradual smooth boundary.
A—8 to 16 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak and moderate coarse subangular blocky structure; very friable; slightly acid; gradual smooth boundary.
Bw—16 to 35 inches; dark yellowish brown (10YR 4/4) loamy fine sand, light yellowish brown (10YR 6/4) dry; weak coarse subangular blocky structure; very friable; medium acid; gradual smooth boundary.
C—35 to 60 inches; yellowish brown (10YR 5/6) fine sand, yellowish brown (10YR 5/6) dry; single grained; very friable; medium acid.

The solum ranges from 24 to 40 inches in thickness. It is loamy sand, loamy fine sand, fine sand, or sand.

The Ap horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The lower part of the A horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The Bw horizon has hue of 10YR or 7.5YR and value and chroma of 3 to 6. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is sand or fine sand.

Taintor Series

The Taintor series consists of poorly drained, moderately slowly permeable soils on upland divides. These soils formed in loess. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Taintor soils are similar to Haig soils and commonly are adjacent to Mahaska soils. The Bt horizon of Haig soils is thicker and more clayey than that of the Taintor soils. The somewhat poorly drained Mahaska soils are slightly higher on the landscape than the Taintor soils. Also, they have a browner B horizon.

Typical pedon of Taintor silt loam, 0 to 2 percent slopes, about 1,280 feet west and 280 feet north of the center of sec. 14, T. 73 N., R. 17 W.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) and gray (10YR 5/1) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.
A1—6 to 12 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; medium acid; gradual smooth boundary.
A2—12 to 18 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
BA—18 to 23 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; dark gray (10YR 4/1) coatings on peds; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; friable; medium acid; gradual smooth boundary.
Btg1—23 to 28 inches; dark gray (10YR 4/1) silty clay loam; very dark gray (10YR 3/1) coatings on peds; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate fine subangular blocky structure; firm; thin discontinuous clay films; medium acid; clear smooth boundary.
Btg2—28 to 34 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to moderate fine subangular blocky; firm; thick discontinuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.
Btg3—34 to 38 inches; olive gray (5Y 5/2) silty clay loam; common fine distinct yellowish brown (10YR

5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films; few dark concretions (iron and manganese oxides); medium acid; gradual smooth boundary.

Btg4—38 to 52 inches; olive gray (5Y 5/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; friable; thin discontinuous clay films on faces of prisms; few dark concretions (iron and manganese oxides); slightly acid; gradual smooth boundary.

Cg—52 to 60 inches; light olive gray (5Y 6/2) silty clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; massive; friable; few dark concretions (iron and manganese oxides); neutral.

The thickness of the solum ranges from 42 to 72 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1. The BA horizon has hue of 10YR or 2.5Y, value of 3, and chroma of 1 or 2. In the upper 20 inches of the argillic horizon, the average content of clay is about 38 to 42 percent and the highest clay content in any subhorizon is about 44 percent. The Btg horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 1 or 2.

Vanmeter Series

The Vanmeter series consists of moderately deep, moderately well drained, very slowly permeable soils on convex side slopes and in escarpmentlike areas that parallel the major streams in the uplands. These soils formed in less than 15 inches of silty and loamy sediments and in the underlying material weathered from calcareous shale. The native vegetation was deciduous trees. Slopes range from 9 to 18 percent.

Vanmeter soils commonly are adjacent to Gara and Pershing soils. Gara soils formed in glacial till on the higher side slopes. Pershing soils formed in loess on the summits of interfluves upslope from the Vanmeter soils.

Typical pedon of Vanmeter silty clay loam, 9 to 14 percent slopes, moderately eroded, about 400 feet south and 2,220 feet west of the northeast corner of sec. 10, T. 73 N., R. 19 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, pale brown (10YR 6/3) dry; mixed with streaks and pockets of light yellowish brown (2.5Y 6/4) silty clay subsoil material; moderate very fine and fine granular structure; firm; moderately alkaline; clear smooth boundary.

BA—6 to 14 inches; mottled light yellowish brown (2.5Y 6/4) and grayish brown (2.5Y 5/2) silty clay; moderate fine and medium subangular blocky structure; very dark gray (N 3/0) coatings; firm; strong effervescence; moderately alkaline; clear smooth boundary.

Bw—14 to 25 inches; yellowish brown (10YR 5/4 and 5/6) clay, light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/6) dry; common medium distinct light olive gray (5Y 6/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very firm; slight effervescence; moderately alkaline; gradual smooth boundary.

Cr—25 to 60 inches; light gray (5Y 6/1 and 7/1) clay shale; common medium prominent yellowish brown (10YR 5/4 and 5/6) mottles; massive; very firm; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 30 inches. The depth to bedrock ranges from 20 to 40 inches. The soils generally are moderately alkaline or mildly alkaline throughout, but some pedons are leached to a depth of 10 inches.

Vesser Series

The Vesser series consists of somewhat poorly drained or poorly drained, moderately permeable soils on bottom land, foot slopes, and alluvial fans. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slopes range from 0 to 5 percent.

Vesser soils commonly are adjacent to Colo, Lawson, and Nodaway soils. They are in positions on the landscape similar to those of the adjacent soils. The mollic epipedon in Colo and Lawson soils is thicker than that in the Vesser soils. Nodaway soils do not have a mollic epipedon.

Typical pedon of Vesser silt loam, 0 to 2 percent slopes, about 1,400 feet south and 200 feet west of the northeast corner of sec. 5, T. 71 N., R. 18 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—7 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine subangular blocky structure; friable; neutral; clear smooth boundary.

E1—13 to 21 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silt loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak medium subangular blocky; friable; neutral; gradual smooth boundary.

E2—21 to 31 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 7/1) dry; few fine faint yellowish brown (10YR 5/4) mottles; weak medium platy structure parting to weak medium subangular blocky; friable; slightly acid; clear smooth boundary.

Btg1—31 to 40 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films and silt coatings; slightly acid; gradual smooth boundary.

Btg2—40 to 51 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; friable; thin discontinuous clay films and silt coatings; slightly acid; gradual smooth boundary.

BCg—51 to 60 inches; dark gray (10YR 4/1) silty clay loam; few fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; firm; slightly acid.

The solum typically is more than 60 inches thick. The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The E horizon is very dark gray (10YR 3/1) to grayish brown (10YR 5/2). The Btg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2. The content of clay in the upper 20 inches of this horizon is 30 to 35 percent.

Weller Series

The Weller series consists of moderately well drained, slowly permeable soils on convex slopes on uplands and stream benches. These soils formed in loess. The native vegetation was deciduous trees. Slopes range from 2 to 14 percent.

Weller soils are similar to Pershing soils and commonly are adjacent to Beckwith, Belinda, Keswick, and Lindley soils. The A horizon of Pershing soils is thicker than that of the Weller soils, and the E horizon is thinner. Beckwith and Belinda soils are higher on the landscape than the Weller soils. Also, they have a lower chroma in the E horizon and in the upper part of the Bt horizon. Keswick soils are lower on the landscape than the Weller soils. Also, their B horizon is more reddish, has a higher content of sand, and formed in glacial till. Lindley soils are lower on the landscape than the Weller soils. Also, they have a higher content of sand and pebbles in the solum and formed in glacial till.

Typical pedon of Weller silt loam, 2 to 5 percent slopes, about 900 feet north and 800 feet west of the southeast corner of sec. 2, T. 71 N., R. 18 W.

A—0 to 4 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 6/1) dry; mixed with streaks and pockets of dark grayish brown (10YR 4/2) subsurface material; weak coarse platy structure; friable; slightly acid; clear smooth boundary.

E1—4 to 7 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate thin platy structure; friable; very strongly acid; clear smooth boundary.

E2—7 to 15 inches; brown (10YR 5/3) silt loam, light yellowish brown (10YR 6/4) dry; weak medium platy structure; friable; very strongly acid; clear smooth boundary.

BE—15 to 19 inches; yellowish brown (10YR 5/4) silty clay loam; brown (10YR 5/3) coatings on peds; moderate fine angular and subangular blocky structure; friable; thin discontinuous silt coatings; light gray (10YR 7/1) dry; very strongly acid; clear smooth boundary.

Bt1—19 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; strong fine and very fine angular and subangular blocky structure; firm; thin discontinuous clay films; thick continuous silt coatings, light gray (10YR 7/1) dry; few dark concretions (iron and manganese oxides); very strongly acid; abrupt smooth boundary.

Bt2—23 to 33 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; moderate fine angular and subangular blocky structure; firm; thick discontinuous clay films; light gray (10YR 7/1) silt coatings when dry; few dark concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt3—33 to 38 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) silty clay loam; weak fine and medium angular and subangular blocky structure; firm; thin discontinuous clay films; few dark concretions (iron and manganese oxides); very strongly acid; gradual smooth boundary.

Bt4—38 to 47 inches; mottled olive gray (5Y 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; firm; thin discontinuous clay films; many dark concretions (iron and manganese oxides); strongly acid; gradual smooth boundary.

Bt5—47 to 60 inches; mottled olive gray (5Y 5/2) and yellowish brown (10YR 5/6) silty clay loam; weak coarse prismatic structure; firm; thin discontinuous clay films; few thin discontinuous silt coatings on the faces of prisms, light gray (10YR 7/1) dry; common dark concretions (iron and manganese oxides); medium acid.

The solum typically is 60 or more inches thick. The A or Ap horizon is very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2). In areas where it has been mixed with the B horizon, the Ap horizon is silt loam or silty clay loam. The Bt horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4) in the upper

part. The content of clay is 42 to 48 percent in the part of this horizon having the highest clay content.

Zook Series

The Zook series consists of poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. The native vegetation was tall prairie grasses. Slopes range from 0 to 2 percent.

Zook soils commonly are adjacent to Colo, Lawson, and Vesser soils. The adjacent soils are in positions on the landscape similar to those of the Zook soils. They are fine-silty.

Typical pedon of Zook silty clay loam, 0 to 2 percent slopes, about 640 feet north and 2,440 feet east of the southwest corner of sec. 4, T. 71 N., R. 19 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; neutral; abrupt smooth boundary.

A1—7 to 15 inches; black (10YR 2/1 and N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A2—15 to 24 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate fine subangular blocky; firm; neutral; gradual smooth boundary.

A3—24 to 33 inches; black (10YR 2/1) and very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to moderate fine subangular blocky; firm; neutral; gradual smooth boundary.

Bg—33 to 45 inches; very dark gray (10YR 3/1) silty clay; few fine faint dark yellowish brown (10YR 4/4 and 4/6) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; neutral; gradual smooth boundary.

Cg—45 to 60 inches; very dark gray (10YR 3/1) silty clay; massive; firm; neutral.

The solum ranges from about 36 to 64 inches in thickness. It is slightly acid to mildly alkaline. It generally is silty clay loam or silty clay. The content of clay is 32 to 44 percent in the upper 16 inches and about 36 to 45 percent in the part of the solum below that depth. The mollic epipedon is more than 36 inches thick. The Bg and Cg horizons are black (10YR 2/1), very dark gray (10YR 3/1), dark gray (10YR to 5Y 4/1), or gray (5Y 5/1).

Zook silt loam, overwash, 0 to 2 percent slopes, is a taxadjunct to the series because the overwash is more than 20 inches thick.

Formation of the Soils

The paragraphs that follow relate the major factors of soil formation to the soils in Monroe County. They also describe the processes of horizon differentiation.

Factors of Soil Formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material (*5*). Human activities also affect soil formation.

Climate and plant and animal life are the active factors of soil formation. They act on the parent material and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always needed for horizon differentiation. A long period generally is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the others.

Parent Material

Parent material has an important effect on the general character of soil profiles. Most of the soils in Monroe County formed in loess, which is windblown material; glacial till, which is ice-laid material; or alluvium, which is water-laid material. These parent materials generally were deposited as layers, which are exposed in road cuts on some side slopes. A few of the soils formed in colluvium, eolian sand, or shale residuum.

The major Pleistocene deposits of pre-Wisconsin age are either Kansan or Nebraskan drift, or both. The different drifts, or tills, are not readily differentiated in Monroe County. The glacial till ranges from 0 to more than 300 feet in thickness.

Soils formed on the Kansan till plain during the Yarmouth and Sangamon interglacial ages. This soil formation took place before Wisconsin loess deposition. On nearly level interstream divides, the soils were strongly weathered and had a gray, plastic subsoil, called "gumbotil." This gumbotil is several feet thick and is very slowly permeable in areas where it is exhumed. Clarinda soils are an example of soils that formed in this exhumed paleosol (*10*).

Geologic erosion cut into and below the Yarmouth-Sangamon paleosol and into the Kansan till and older deposits during the Late Sangamon period. On the surface formed by this erosion, a stone line remains on top of the till and erosional sediments, which are called pedisediments. Soils that have a red, clayey subsoil formed in the pedisediments, stone line, and subjacent till. Adair soils formed in the Late Sangamon paleosol (*10*).

The Kansan till is exposed mainly in hilly areas. The unweathered till is firm, calcareous clay loam. It contains pebbles, boulders, and sand, as well as silt and clay. The soils that formed in Kansan till during Yarmouth and Sangamon ages were covered by loess. Geologic erosion has removed the loess and paleosol from many of the side slopes. In these areas the till is only slightly weathered at the surface. It was exposed only during the Wisconsin stage of the Quaternary period (*10*). Gara, Lindley, and Shelby soils formed in this slightly weathered glacial till.

Loess of Wisconsin age covers most of Monroe County. It is an extensive parent material in the county. It consists mainly of silt and clay particles that have been deposited by wind. Variations in the loess are related to the distance from the source of the loess. The source in Monroe County is probably the bottom land to the northwest and the Des Moines River. The major deposits of loess are more than 14,000 years old (*10*). On the stable upland divides of the Kansan till plain, the loess is about 8 1/2 feet thick. Edina, Grundy, and Haig soils formed in loess on this plain.

Alluvium is the parent material of the soils on flood plains, on low terraces, and in long drainageways. It is deposited when rivers or streams overflow their channels. As the floodwater spreads over the flood plains, coarse textured material, such as sand and coarse silt, are deposited first. As the floodwater continues to spread, it moves more slowly and the finer textured sediments are deposited. As the floodwater recedes, clay particles, which are the finest textured

particles, settle from the water that is left standing on the lowest part of the flood plain.

Colo, Koszta, Lawson, Nodaway, and Zook soils formed in alluvium. Lawson and Nodaway soils commonly are closest to the stream channel and are coarser textured than the other soils on flood plains. Colo soils are in upland drainageways and on the flood plains along the larger streams. Zook soils commonly are on the lower parts of the bottom land. They are one of the finest textured of the soils that formed in alluvium in the county. Alluvial stream terraces are intermediate in elevation between the flood plains and the loess-covered benches. Koszta soils formed in the silty alluvium on these terraces.

Sediments that accumulated at the foot of the slope on which they originated are called colluvium or local alluvium. Ely and Vesser soils formed in the sediments on these foot slopes. Alluvial sediments that were carried in from distant sources are downslope from these soils.

In some areas the wind has carried fine sand from the stream channels and the flood plains to higher elevations (*8*). This dune sand has been deposited on low stream terraces, high benches, and uplands fringing the leeward side of valleys. Sparta soils formed in eolian sand that is more than 5 feet thick.

Shale residuum is the oldest parent material in the county. The shale consists of a series of beds deposited during the Des Moines sedimentary cycle in the Pennsylvanian period. These beds include shale of different colors and textures, conglomerates, and a few organic layers, such as layers of coal. The beds have a wide range in thickness. The soils in southern Iowa that formed in material weathered from shale have a wide range of texture, reaction, and other characteristics. The shale is dominantly red, brown, or grayish, but the color ranges from nearly black to red. Thin beds of sandstone and coal are between the layers of shale in some areas. Exposures of shale and sandstone (fig. 19) are common in the northeastern part of the county (*8*).

Climate

The soils in Monroe County have been forming under a midcontinental, subhumid climate for the past 5,000 years. From 6,500 to 16,000 years ago, however, the climate probably was cool and moist and was conducive to the growth mainly of forest vegetation.

The influence of the general climate in a region is modified by local conditions. For example, soils on south-facing slopes form under a microclimate that is warmer and drier than the average climate in nearby areas. The climate under which the low lying, poorly drained soils on bottom land form is wetter and colder than that in most of the surrounding areas. These local conditions account for some of the differences among soils in the same climatic region.

Plant and Animal Life

The climate and vegetation in Iowa have frequently changed during the past 28,000 years (*9*). The period from 28,000 to 11,000 years ago was dominated by coniferous forest. Birch and alder were mixed with the conifers at the end of this period. Deciduous forest dominated the period from 11,000 to 9,000 years ago. Prairie vegetation dominated the very dry period from 9,000 to 3,200 years ago. It is still dominant, even though trees, especially oaks, have invaded the prairie. Both the trees and the prairie grasses have probably affected soil formation for the past 5,000 years.

The native vegetation on the nearly level and gently rolling uplands was legumes, bluestem, indiangrass, and switchgrass. It grew on the poorly drained and somewhat poorly drained soils in the southwestern, northeastern, and central parts of the county. It has been replaced by bluegrass or eliminated through cultivation in all areas, except for those along the right-of-ways of railroads and the banks of county roads.

Elm, hickory, oak, cedar, and ash grew on the steep side slopes. Cottonwood, walnut, willow, hackberry, basswood, and maple grew along the major streams. In many areas the trees were removed for lumber and fuel when the county was settled. Gooseberry, sumac, raspberry, blackberry, coralberry, and elderberry invade the cutover areas until the trees are reestablished. Wild plum and honeylocust grow in the open areas throughout the county.

The soils that formed under forest vegetation generally are lighter colored and more acid than the soils that formed under grasses. Also, their surface layer is thinner and has a lower content of organic matter. The soils that formed under mixed grasses and trees have properties that are intermediate between those of soils that formed under grasses and those of soils that formed under forest vegetation. The morphology of Armstrong, Belinda, Gara, and Pershing soils reflects the influence of both trees and grasses. That of Beckwith, Lindley, and Weller soils reflects the influence of trees (*7*). That of Arispe, Colo, Edina, Grundy, Haig, Shelby, and Zook soils reflects the influence of grasses.

The animals living on and in the soil also affect soil formation. Earthworms and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose the vegetation, thus releasing plant nutrients.

Relief

Relief may cause important differences among soils. It indirectly affects soil formation through its effect on drainage. The slope of the soils in Monroe County ranges from nearly level to very steep. Nearly level soils are on the broad upland flats and on bottom land. The steepest soils generally are on upland slopes near the major streams and their tributaries. The nearly level soils

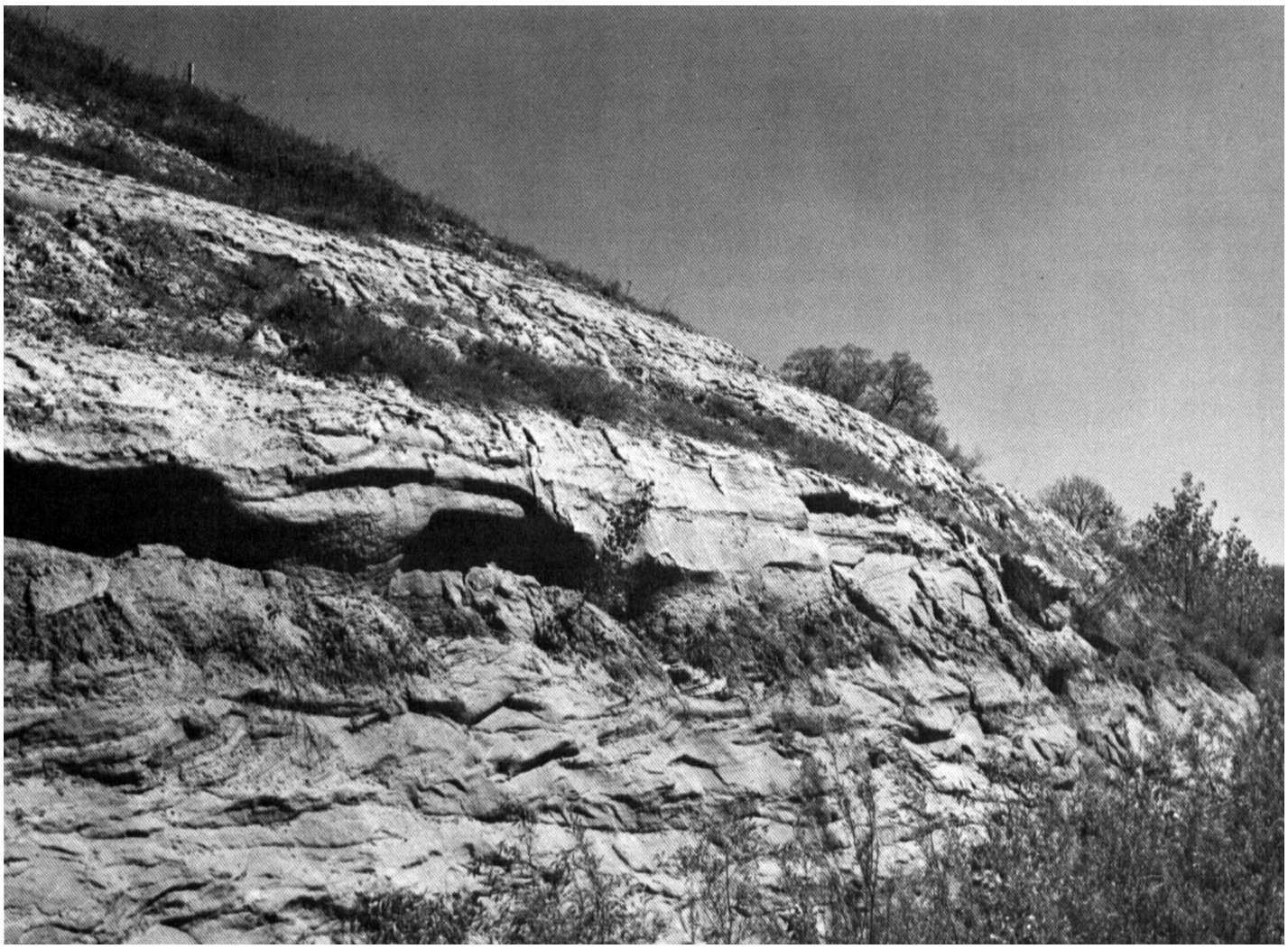


Figure 19.—Exposure of sandstone bedrock in a road cut near Lovilia.

in many areas on bottom land are occasionally flooded and have a permanently or periodically high water table. Water soaks into the nearly level soils in depressions that are subject to flooding. In contrast, much of the rainfall runs off the steeper soils on uplands.

Generally, the soils that formed in areas where the seasonal high water table was below a depth of 6 feet have a yellowish brown subsoil. Examples are Clinton, Ladoga, and Otley soils. Grundy, Mahaska, and other soils formed in areas where the water table fluctuated and was periodically high. The poorly drained Colo, Haig, Taintor, and Zook soils also formed in areas where the water table was periodically high. The subsoil of Haig and Taintor soils is dominantly grayish. Colo and Zook soils formed under prairie grasses. Their surface layer contains more organic matter than that of the well drained soils that formed under prairie grasses. Clay accumulates in the subsoil of Edina and other soils that are slightly depressional or nearly level. A large amount of water enters the soils and carries the clay particles downward. These soils are considered "claypan" soils because the layer having the highest content of accumulated clay is hard.

Time

Most of the parent materials in Monroe County are thousands of years old. The present land surface and many of the soils, however, are much younger because of recent geologic erosion (*10*). The older soils have well defined genetic horizons, whereas the younger soils have only weakly defined ones. An increase in the

content of clay from the surface soil to the subsoil indicates the effects of time. A high content of clay in the subsoil indicates a high degree of profile development.

Most of the soils on flood plains have only weakly defined horizons because they have not been in place long enough for the formation of distinct horizons. Soil material generally is removed from steep slopes before enough time has passed for the development of a thick profile with strongly expressed horizons. Much of the water runs off the slopes rather than through the soil material. Even though the material has been in place for a long time, the soil may exhibit little profile development.

Clarinda and Rinda soils are among the oldest soils in the county. They formed in Kansan glacial till during the Yarmouth-Sangamon period. This parent material is much older than the loess in the county. Edina, Grundy, Haig, Mahaska, and Taintor soils, which formed in loess, might be as much as 14,000 years old (*9*). Koszta and other soils on stream terraces are the oldest of the soils that formed in alluvium. Colo and Nodaway soils, which formed in alluvial material on flood plains, are younger than Koszta soils. They are less than 125 years old.

Human Activities

Important changes take place when a soil is cultivated. Some of these changes have little effect on productivity; others have a drastic effect. The changes caused by erosion generally are the most drastic. The soils are eroded on about 46 percent of the acreage in the county. On many of the cultivated soils, particularly the gently rolling to hilly ones, part or all of the original surface layer has been lost through sheet erosion. In some areas shallow to deep gullies have formed. According to a study of eroded soils in Iowa started in 1974 by the Iowa Cooperative Soil Survey, the content of organic matter is lower in eroded soils than in uneroded soils. Nodaway soils formed in stratified, silty alluvium on alluvial fans and flood plains. This alluvium has been deposited during the past 125 years, which is the period of cultivation. It was eroded from many of the more sloping adjacent soils, which lost topsoil after they were cultivated.

In many fields that are cultivated year after year, the granular structure that was apparent when the grassland was undisturbed is no longer evident. In these fields the surface tends to form a crust and harden when it dries. Fine textured soils that have been plowed when too wet tend to puddle and are less permeable than similar soils in uncultivated areas. The puddling and restricted permeability result in poor seedling emergence and root penetration.

Some management measures have increased soil productivity or reclaimed areas not suitable for crops. For example, large areas on bottom land are suitable for cultivation because drainage ditches have been dug and diversions and dikes have been constructed. The suitability of some soils for cultivation has been greatly improved by a drainage system. Examples are Haig, Taintor, and other nearly level soils on broad flats. Because applications of commercial fertilizer have counteracted deficiencies in plant nutrients, some soils are more productive than they were in their natural state.

Processes of Horizon Differentiation

Horizons are differentiated from each other when four basic kinds of change take place. These are additions, removals, transfers, and transformations (*11*). Each of these kinds of change affects many substances in the soils, such as organic matter, soluble salts, carbonates, sesquioxides, and silicate clay minerals. Most of these processes tend to promote horizon differentiation, but some tend to offset or retard it. The processes and the resulting changes occur simultaneously in soils. The ultimate nature of the profile is governed by the balance of these changes within the soil.

An accumulation of organic matter generally is an early phase of horizon differentiation. It has been an important process in the differentiation of horizons in the soils of Monroe County. The amount of organic matter that has accumulated in the surface layer of the soils ranges from high to very low. In some soils the content of organic matter formerly was fairly high but is now low because of erosion.

The removal of substances from parts of the soil profile is important in the differentiation of horizons. The downward movement of calcium carbonates and bases is an example. The upper part of nearly all of the soils in the county has been leached of calcium carbonates. Vanmeter soils are the only exception. Many soils have been so strongly leached that they are strongly acid or very strongly acid even in the subsoil.

Phosphorus is removed from the subsoil by plant roots and transferred to the parts of the plant growing above the ground. It is then returned to the surface layer in the plant residue. This process affects the form and distribution of phosphorus in the profile. The translocation of silicate clay minerals is another important process. The clay minerals in the surface layer are carried downward in suspension by percolating water. They accumulate in the subsoil as fillings in pores and root channels and as clay films. This process has affected many of the soils in the county. In other soils, however, the clay content of the surface layer is not markedly different from that of the underlying layer and other evidence of clay movement is minimal.

Another kind of transfer occurs when cracks form as a result of shrinking and swelling. Because of the cracks, some of the material from the surface layer is transferred to the lower parts of the profile. This transfer is minimal in most soils. It is most common in very clayey soils. It can occur in Clarinda soils.

Transformations are physical and chemical. The weathering of soil particles to smaller sizes is an example of a transformation. The reduction of iron is another example. This process is called gleying. It occurs when the soil is saturated for long periods. The soil contains enough organic matter for biologic activity to take place during the periods of saturation. Gleying is evidenced by ferrous iron and gray colors in the soil. It is a characteristic of poorly drained soils, such as Haig soils. The content of reductive extractable iron, or free iron, generally is lower in somewhat poorly drained soils, such as Mahaska soils (*13*). Another kind of transformation is the weathering of the primary apatite minerals in the parent material to secondary phosphorus compounds.

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Glossary

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.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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

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

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

Bedding. Draining the soil through a series of broad beds made by plowing, grading, or otherwise elevating the surface of a flat field.

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

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

Bottom land. The normal flood plain of a stream, subject to flooding.

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

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.

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 shatter or loosen hard compacted layers to a depth below normal plow depth.

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

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, 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 constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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 tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

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

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

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

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

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.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

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

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 ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and 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 flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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.

Glacial drift (geology). 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 (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

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

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 up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). 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.

Gumbotil. A leached, deoxidized clay containing siliceous stones; the product of thorough chemical weathering of clay-rich glacial till.

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

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

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

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

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

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

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

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

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.

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.

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

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

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

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

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

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

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.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

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

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

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.

Paleosol. A buried or formerly buried soil. An example is a soil that formed during an interglacial period and was then covered by material deposited by subsequent glaciers.

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

Pedisediment. Water-sorted sediment at the top of a paleosol.

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

Percolation. The downward movement of water through the soil.

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

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

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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, 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.

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.

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

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

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

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

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

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

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

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.

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-size particles.

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.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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 insure satisfactory performance of the soil for a specific use.

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.

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 of separates recognized in the United States are as follows:

	Millimeters
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 underlying material. The living roots and plant and animal activities are largely confined to the solum.

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

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

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

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. Includes all subdivisions of these horizons.

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.

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.

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

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

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 melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Water table (seasonal high). The highest level of a saturated zone in the soil in most years.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

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

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

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data were recorded in the period 1951-79 at Albia, Iowa]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	30.3	12.1	21.2	58	-18	0	1.23	0.50	1.84	4	9.2
February---	37.0	18.0	27.5	64	-15	7	1.14	.54	1.65	4	6.5
March------	47.5	27.6	37.6	80	-1	46	2.69	1.27	3.90	7	7.3
April------	63.1	41.0	52.1	87	20	135	3.84	2.08	5.39	8	1.4
May--------	74.2	51.6	62.9	91	32	405	4.38	2.42	6.10	8	.0
June-------	83.0	60.8	71.9	97	45	657	4.34	2.41	6.03	8	.0
July-------	87.5	65.3	76.4	100	50	818	4.15	1.90	6.08	7	.0
August-----	85.3	63.0	74.2	99	48	750	3.86	1.66	5.73	6	.0
September--	77.7	54.5	66.1	95	35	483	4.05	1.70	6.03	7	.0
October----	67.3	44.2	55.8	89	23	225	2.59	.59	4.15	5	.1
November---	50.0	30.8	40.4	75	6	16	2.02	.48	3.22	4	2.5
December---	36.5	19.6	28.1	63	-10	0	1.24	.53	1.84	4	5.7
Yearly:											
Average--	61.6	40.7	51.2	---	---	---	---	---	---	---	---
Extreme--	---	---	---	101	-18	---	---	---	---	---	---
Total----	---	---	---	---	---	3,542	35.53	28.61	42.06	72	32.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data were recorded in the period 1951-79 at Albia, Iowa]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 18	April 23	May 7
2 years in 10 later than--	April 13	April 19	May 2
5 years in 10 later than--	April 3	April 12	April 23
First freezing temperature in fall:			
1 year in 10 earlier than--	October 22	October 13	October 2
2 years in 10 earlier than--	October 27	October 18	October 7
5 years in 10 earlier than--	November 4	October 27	October 17

TABLE 3.--GROWING SEASON

[Data were recorded in the period 1951-79 at Albia, Iowa]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	195	180	156
8 years in 10	201	186	163
5 years in 10	214	198	176
2 years in 10	227	209	189
1 year in 10	234	215	196

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes	6,700	2.4
13B	Olmitz-Colo-Vesser complex, 2 to 5 percent slopes	10,175	3.7
23C	Arispe silty clay loam, 5 to 9 percent slopes	3,465	1.2
23C2	Arispe silty clay loam, 5 to 9 percent slopes, moderately eroded	5,730	2.1
24D2	Shelby clay loam, 9 to 14 percent slopes, moderately eroded	850	0.3
24E2	Shelby clay loam, 14 to 18 percent slopes, moderately eroded	395	0.1
41D	Sparta loamy fine sand, 5 to 14 percent slopes	75	*
51	Vesser silt loam, 0 to 2 percent slopes	1,025	0.4
54	Zook silty clay loam, 0 to 2 percent slopes	2,750	1.0
54+	Zook silt loam, overwash, 0 to 2 percent slopes	1,200	0.4
58D2	Douds loam, 9 to 14 percent slopes, moderately eroded	1,100	0.4
58E2	Douds loam, 14 to 18 percent slopes, moderately eroded	490	0.2
65D	Lindley loam, 9 to 14 percent slopes	250	0.1
65E	Lindley loam, 14 to 18 percent slopes	3,145	1.1
65E2	Lindley loam, 14 to 18 percent slopes, moderately eroded	2,205	0.8
65G	Lindley loam, 18 to 40 percent slopes	12,205	4.4
76B	Ladoga silt loam, 2 to 5 percent slopes	745	0.3
76C	Ladoga silt loam, 5 to 9 percent slopes	790	0.3
76C2	Ladoga silt loam, 5 to 9 percent slopes, moderately eroded	2,625	0.9
76D	Ladoga silt loam, 9 to 14 percent slopes	415	0.1
76D2	Ladoga silt loam, 9 to 14 percent slopes, moderately eroded	1,650	0.6
80D	Clinton silt loam, 9 to 14 percent slopes	305	0.1
80D2	Clinton silty clay loam, 9 to 14 percent slopes, moderately eroded	580	0.2
130	Belinda silt loam, 0 to 2 percent slopes	7,925	2.8
131B	Pershing silt loam, 2 to 5 percent slopes	9,430	3.4
131C	Pershing silt loam, 5 to 9 percent slopes	12,195	4.4
132B	Weller silt loam, 2 to 5 percent slopes	1,390	0.5
132C	Weller silt loam, 5 to 9 percent slopes	4,970	1.8
133	Colo silty clay loam, 0 to 2 percent slopes	2,395	0.9
133B	Colo silty clay loam, 2 to 5 percent slopes	1,525	0.5
133+	Colo silt loam, overwash, 0 to 2 percent slopes	800	0.3
179D2	Gara loam, 9 to 14 percent slopes, moderately eroded	5,340	1.9
179E2	Gara loam, 14 to 18 percent slopes, moderately eroded	14,740	5.4
179F	Gara loam, 18 to 25 percent slopes	7,570	2.7
179F2	Gara loam, 18 to 25 percent slopes, moderately eroded	4,340	1.6
192D2	Adair clay loam, 9 to 14 percent slopes, moderately eroded	280	0.1
211	Edina silt loam, 0 to 1 percent slopes	1,025	0.4
220	Nodaway silt loam, 0 to 2 percent slopes	3,915	1.4
222C	Clarinda silty clay loam, 5 to 9 percent slopes	275	0.1
222C2	Clarinda silty clay loam, 5 to 9 percent slopes, moderately eroded	2,260	0.8
222D2	Clarinda silty clay loam, 9 to 14 percent slopes, moderately eroded	995	0.4
223C2	Rinda silty clay loam, 5 to 9 percent slopes, moderately eroded	1,655	0.6
223D2	Rinda silty clay loam, 9 to 14 percent slopes, moderately eroded	5,300	1.9
260	Beckwith silt loam, 0 to 2 percent slopes	600	0.2
263	Okaw silt loam, 0 to 2 percent slopes	860	0.3
273C	Olmitz loam, 5 to 9 percent slopes	900	0.3
279	Taintor silt loam, 0 to 2 percent slopes	645	0.2
280	Mahaska silty clay loam, 0 to 2 percent slopes	2,250	0.8
281B	Otley silty clay loam, 2 to 5 percent slopes	1,910	0.7
281C	Otley silty clay loam, 5 to 9 percent slopes	360	0.1
281C2	Otley silty clay loam, 5 to 9 percent slopes, moderately eroded	1,000	0.4
313D	Gosport silt loam, 9 to 14 percent slopes	730	0.3
313D2	Gosport silt loam, 9 to 14 percent slopes, moderately eroded	5,425	1.9
313E	Gosport silt loam, 14 to 18 percent slopes	4,270	1.5
313E2	Gosport silt loam, 14 to 18 percent slopes, moderately eroded	5,105	1.8
313F	Gosport silt loam, 18 to 25 percent slopes	4,950	1.8
362	Haig silty clay loam, 0 to 2 percent slopes	9,320	3.3
364B	Grundy silty clay loam, 2 to 5 percent slopes	6,225	2.2
419D2	Vanmeter silty clay loam, 9 to 14 percent slopes, moderately eroded	1,275	0.5
419E2	Vanmeter silty clay loam, 14 to 18 percent slopes, moderately eroded	360	0.1
423D2	Bucknell silty clay loam, 9 to 14 percent slopes, moderately eroded	6,760	2.4
424E2	Lindley-Keswick loams, 14 to 18 percent slopes, moderately eroded	1,080	0.4
425C	Keswick loam, 5 to 9 percent slopes	1,645	0.6
425D	Keswick loam, 9 to 14 percent slopes	1,890	0.7
425D2	Keswick loam, 9 to 14 percent slopes, moderately eroded	815	0.3
428B	Ely silty clay loam, 2 to 5 percent slopes	225	0.1
452C	Lineville silt loam, 5 to 9 percent slopes	1,800	0.6
478G	Gosport-Rock outcrop complex, 14 to 40 percent slopes	3,300	1.2
484	Lawson silt loam, 0 to 2 percent slopes	5,720	2.1
594C2	Galland loam, 5 to 9 percent slopes, moderately eroded	270	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
594D2	Galland loam, 9 to 14 percent slopes, moderately eroded	600	0.2
688	Koszta silt loam, 0 to 2 percent slopes	540	0.2
731C2	Pershing silty clay loam, 5 to 9 percent slopes, moderately eroded	19,695	7.2
731D2	Pershing silty clay loam, 9 to 14 percent slopes, moderately eroded	8,440	3.0
732C2	Weller silty clay loam, 5 to 9 percent slopes, moderately eroded	5,650	2.0
732D2	Weller silty clay loam, 9 to 14 percent slopes, moderately eroded	1,130	0.4
792C2	Armstrong loam, 5 to 9 percent slopes, moderately eroded	2,550	0.9
792D2	Armstrong loam, 9 to 14 percent slopes, moderately eroded	8,925	3.2
795D	Ashgrove silt loam, 9 to 14 percent slopes	580	0.2
822D2	Lamoni clay loam, 9 to 14 percent slopes, moderately eroded	1,550	0.6
832C2	Weller silty clay loam, benches, 5 to 9 percent slopes, moderately eroded	810	0.3
876B	Ladoga silt loam, benches, 2 to 5 percent slopes	240	0.1
876C2	Ladoga silt loam, benches, 5 to 9 percent slopes, moderately eroded	675	0.2
993D2	Gara-Armstrong loams, 9 to 14 percent slopes, moderately eroded	4,860	1.7
993E2	Gara-Armstrong loams, 14 to 18 percent slopes, moderately eroded	1,730	0.6
1130	Belinda silt loam, benches, 0 to 2 percent slopes	215	0.1
1131C	Pershing silt loam, benches, 5 to 9 percent slopes	510	0.2
1279	Taintor silt loam, benches, 0 to 2 percent slopes	225	0.1
5020	Pits and Dumps	380	0.1
5021	Orthents, hilly	265	0.1
5030	Pits, quarries	115	*
5040	Orthents, loamy	230	0.1
	Water	1,600	0.6
	Total	278,400	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
11B	Colo-Ely silty clay loams, 2 to 5 percent slopes (where drained)
13B	Olmitz-Colo-Vesser complex, 2 to 5 percent slopes (where drained)
51	Vesser silt loam, 0 to 2 percent slopes (where drained)
54	Zook silty clay loam, 0 to 2 percent slopes (where drained)
54+	Zook silt loam, overwash, 0 to 2 percent slopes (where drained)
76B	Ladoga silt loam, 2 to 5 percent slopes
130	Belinda silt loam, 0 to 2 percent slopes (where drained)
131B	Pershing silt loam, 2 to 5 percent slopes
132B	Weller silt loam, 2 to 5 percent slopes
133	Colo silty clay loam, 0 to 2 percent slopes (where drained)
133B	Colo silty clay loam, 2 to 5 percent slopes (where drained)
133+	Colo silt loam, overwash, 0 to 2 percent slopes (where drained)
211	Edina silt loam, 0 to 1 percent slopes (where drained)
220	Nodaway silt loam, 0 to 2 percent slopes
279	Taintor silt loam, 0 to 2 percent slopes (where drained)
280	Mahaska silty clay loam, 0 to 2 percent slopes
281B	Otley silty clay loam, 2 to 5 percent slopes
362	Haig silty clay loam, 0 to 2 percent slopes (where drained)
364B	Grundy silty clay loam, 2 to 5 percent slopes
428B	Ely silty clay loam, 2 to 5 percent slopes
484	Lawson silt loam, 0 to 2 percent slopes
688	Koszta silt loam, 0 to 2 percent slopes
876B	Ladoga silt loam, benches, 2 to 5 percent slopes
1130	Belinda silt loam, benches, 0 to 2 percent slopes (where drained)
1279	Taintor silt loam, benches, 0 to 2 percent slopes (where drained)

TABLE 6.--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	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
11B---------- Colo-Ely	111	42	84	4.6	4.1	6.2	7.7
13B---------- Olmitz-Colo-Vesser	99	38	61	4.1	3.9	5.5	6.6
23C---------- Arispe	105	40	79	4.4	3.8	6.3	7.3
23C2---------- Arispe	102	39	76	4.3	3.7	6.1	7.1
24D2---------- Shelby	81	31	44	3.4	3.3	4.9	5.6
24E2---------- Shelby	66	25	36	2.7	2.1	4.0	4.5
41D---------- Sparta	---	---	---	2.2	2.0	3.9	4.4
51---------- Vesser	95	36	52	4.0	3.7	5.0	5.6
54---------- Zook	96	36	72	4.0	4.0	4.0	4.5
54+---------- Zook	101	38	75	4.2	4.4	4.4	4.5
58D2---------- Douds	64	24	33	2.6	1.9	2.7	4.3
58E2---------- Douds	---	---	17	1.7	1.5	3.0	2.8
65D---------- Lindley	69	26	32	3.0	2.3	6.0	7.0
65E, 65E2---------- Lindley	---	---	---	2.2	1.4	4.4	4.5
65G---------- Lindley	---	---	---	1.8	1.2	2.0	3.8
76B---------- Ladoga	113	43	62	4.7	4.3	6.8	7.8
76C---------- Ladoga	108	41	59	4.5	4.0	6.5	7.5
76C2---------- Ladoga	105	40	57	4.4	3.9	6.3	7.3
76D---------- Ladoga	99	38	54	4.2	3.8	5.9	7.0
76D2---------- Ladoga	96	36	53	4.0	3.7	5.7	6.6
80D---------- Clinton	93	35	51	3.9	3.6	5.6	6.5

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
80D2---------- Clinton	90	34	50	3.8	3.5	5.3	6.3
130---------- Belinda	87	33	48	3.7	3.7	5.1	6.1
131B---------- Pershing	101	38	56	4.2	3.8	6.0	7.0
131C---------- Pershing	96	36	53	4.0	3.5	5.7	6.6
132B---------- Weller	95	36	52	4.0	3.8	5.6	6.6
132C---------- Weller	90	34	50	3.8	3.7	5.4	6.3
133---------- Colo	104	40	78	4.2	4.2	5.5	7.0
133B---------- Colo	102	39	76	4.0	4.2	5.3	6.6
133+---------- Colo	109	42	82	4.3	4.2	5.8	7.0
179D2---------- Gara	75	28	41	3.1	2.5	4.5	5.1
179E2---------- Gara	---	---	---	2.2	1.5	4.4	3.8
179F---------- Gara	---	---	---	1.5	1.3	4.0	2.5
179F2---------- Gara	---	---	---	1.2	1.3	3.8	2.0
192D2---------- Adair	54	20	30	2.3	1.9	2.9	3.8
211---------- Edina	86	33	---	3.4	3.0	6.8	7.0
220---------- Nodaway	110	42	60	3.0	4.0	5.5	7.0
222C---------- Clarinda	63	24	34	2.6	2.7	3.7	4.3
222C2---------- Clarinda	55	21	30	2.2	2.3	3.3	3.6
222D2---------- Clarinda	46	17	25	1.8	1.7	2.9	3.0
223C2---------- Rinda	52	20	29	2.1	2.3	3.3	3.5
223D2---------- Rinda	42	16	23	1.7	1.7	2.5	2.8
260---------- Beckwith	76	23	42	3.3	3.0	4.5	5.5
263---------- Okaw	84	28	54	3.1	2.8	4.3	5.2

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
273C---------- Olmitz	95	36	52	4.0	3.7	5.7	6.6
279---------- Taintor	117	44	64	4.7	4.2	7.0	7.8
280---------- Mahaska	125	48	69	5.2	4.5	7.5	8.6
281B---------- Otley	119	45	65	5.0	4.3	7.1	8.3
281C---------- Otley	114	43	63	4.8	4.0	6.8	8.0
281C2---------- Otley	111	42	61	4.7	3.9	6.6	7.8
313D---------- Gosport	---	---	---	2.2	1.3	2.0	3.6
313D2---------- Gosport	---	---	---	2.0	1.0	1.7	3.3
313E, 313E2, 313F--------- Gosport	---	---	---	1.5	1.0	1.0	2.5
362---------- Haig	105	40	58	4.2	3.8	6.2	7.0
364B---------- Grundy	98	38	56	4.4	4.0	8.8	7.4
419D2---------- Vanmeter	---	---	---	2.0	1.5	3.0	3.5
419E2---------- Vanmeter	---	---	---	1.0	1.0	1.0	2.5
423D2---------- Bucknell	46	19	31	2.4	1.9	3.5	4.1
424E2---------- Lindley-Keswick	---	---	---	1.6	2.2	2.9	3.5
425C---------- Keswick	61	23	33	2.6	2.1	3.7	4.3
425D---------- Keswick	52	20	29	2.2	1.9	3.1	3.6
425D2---------- Keswick	44	17	24	1.8	1.3	2.7	3.0
428B---------- Ely	124	47	93	5.3	4.0	7.5	8.8
452C---------- Lineville	70	27	38	2.9	2.5	3.5	4.1
478G. Gosport-Rock outcrop							
484---------- Lawson	119	45	90	5.0	4.1	5.2	8.3
594C2---------- Galland	54	20	30	2.3	1.9	3.1	3.8

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Kentucky bluegrass	Smooth bromegrass	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
594D2---------- Galland	45	17	25	1.8	1.3	2.7	3.0
688---------- Koszta	108	41	59	4.5	3.7	6.5	7.5
731C2---------- Pershing	91	33	50	3.8	3.4	5.4	6.3
731D2---------- Pershing	80	30	44	3.4	3.3	4.8	5.6
732C2---------- Weller	85	32	46	3.2	3.5	5.0	5.5
732D2---------- Weller	76	29	42	2.8	2.7	4.5	4.6
792C2---------- Armstrong	59	22	33	2.5	2.1	3.1	4.1
792D2---------- Armstrong	50	19	28	2.0	1.7	2.7	3.3
795D---------- Ashgrove	45	15	24	1.8	1.7	2.0	3.0
822D2---------- Lamoni	61	23	33	2.6	2.1	3.7	4.3
832C2---------- Weller	85	32	46	3.2	3.5	5.0	5.5
876B---------- Ladoga	113	43	62	4.7	4.3	6.8	7.8
876C2---------- Ladoga	105	40	57	4.4	3.9	6.3	7.3
993D2---------- Gara-Armstrong	67	25	36	2.8	2.3	3.9	4.5
993E2---------- Gara-Armstrong	---	---	---	2.2	1.6	2.6	3.6
1130---------- Belinda	87	33	48	3.7	3.7	5.1	6.1
1131C---------- Pershing	96	36	53	4.0	3.5	5.7	6.6
1279---------- Taintor	117	44	64	4.7	4.2	7.0	7.8
5020**. Pits and Dumps							
5021**. Orthents							
5030**. Pits							
5040**. Orthents							

* 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.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	2,790	---	---	---
II	55,740	9,345	46,395	---
III	90,885	80,260	10,625	---
IV	53,400	53,400	---	---
V	---	---	---	---
VI	38,465	38,390	---	75
VII	34,530	34,530	---	---
VIII	---	---	---	---

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
41D---------- Sparta	3s	Slight	Slight	Severe	Slight	Northern red oak----	70	Northern red oak, eastern white pine, red pine, jack pine, black walnut, white ash.
						White oak----------	---	
58D2---------- Douds	4o	Slight	Slight	Slight	Slight	White oak----------	55	White oak, northern red oak, eastern white pine, red pine, Norway spruce, Scotch pine, white spruce, sugar maple, green ash.
						Northern red oak----	55	
						Black oak----------	---	
58E2---------- Douds	4r	Moderate	Moderate	Slight	Slight	White oak----------	55	Eastern white pine, white oak, northern red oak, red pine, Norway spruce, Scotch pine, white spruce, sugar maple, green ash.
						Northern red oak----	55	
65D---------- Lindley	4o	Slight	Slight	Slight	Slight	White oak----------	60	White oak, green ash, northern red oak, black oak, black walnut, white ash.
						Post oak----------	---	
						Black oak----------	---	
						Bur oak----------	---	
						Shagbark hickory----	---	
65E, 65E2, 65G----- Lindley	4r	Moderate	Moderate	Slight	Slight	White oak----------	60	White oak, green ash, northern red oak, black oak, black walnut, white ash.
						Post oak----------	---	
						Blackjack oak-------	---	
						Black oak----------	---	
						Shingle oak---------	---	
						Shagbark hickory----	---	
76B, 76C, 76C2, 76D, 76D2--------- Ladoga	2o	Slight	Slight	Slight	Moderate	White oak----------	75	Eastern white pine, red pine, white oak, sugar maple, northern red oak, black walnut.
						Northern red oak----	75	
80D, 80D2---------- Clinton	3o	Slight	Slight	Slight	Moderate	White oak----------	65	Eastern white pine, red pine, black walnut, white oak, northern red oak.
						Northern red oak----	65	
130---------- Belinda	5w	Slight	Severe	Moderate	Severe	White oak----------	45	Eastern cottonwood, silver maple, white oak, green ash, northern white-cedar.
						Black oak----------	---	
						Bur oak----------	---	
131B, 131C---------- Pershing	4c	Slight	Slight	Severe	Slight	White oak----------	55	Eastern white pine, white oak, red pine, white ash.
						Shagbark hickory----	---	
132B, 132C---------- Weller	4c	Slight	Slight	Severe	Slight	White oak----------	55	Eastern white pine, white oak, red pine, black walnut, sugar maple, white ash.
						Shagbark hickory----	---	

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
179D2--------- Gara	3o	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, red pine, white oak, northern red oak, white ash.
						Northern red oak----	55	
						Shagbark hickory----	---	
						Black oak----------	---	
179E2, 179F, 179F2- Gara	3r	Moderate	Moderate	Slight	Slight	White oak----------	55	Eastern white pine, red pine, white oak, northern red oak, white ash.
						Northern red oak----	55	
						Shagbark hickory----	---	
						Black oak----------	---	
223C2, 223D2------- Rinda	5w	Slight	Severe	Moderate	Severe	White oak----------	45	Silver maple, green ash, white oak, hackberry, white spruce, Norway spruce, northern red oak.
						Northern red oak----	45	
						Black oak----------	---	
						Bur oak----------	---	
260--------- Beckwith	5w	Slight	Severe	Moderate	Severe	White oak----------	45	Eastern cottonwood, white oak, silver maple, green ash.
263--------- Okaw	4w	Slight	Severe	Severe	Severe	Pin oak----------	70	Pin oak, black oak, green ash, red maple, swamp white oak, silver maple.
						Black oak----------	55	
						White oak----------	---	
313D, 313D2-------- Gosport	5c	Slight	Slight	Severe	Slight	White oak----------	45	Eastern white pine, white oak, red pine, Norway spruce, Scotch pine, white spruce, cottonwood.
						Black oak----------	---	
313E, 313E2, 313F-- Gosport	5c	Moderate	Moderate	Severe	Slight	White oak----------	45	Eastern white pine, white oak, red pine, Norway spruce, Scotch pine, white spruce, cottonwood.
						Black oak----------	---	
419D2, 419E2------- Vanmeter	5c	Moderate	Moderate	Severe	Slight	White oak----------	45	Eastern white pine, white oak, red pine.
						Black oak----------	---	
423D2--------- Bucknell	5c	Slight	Slight	Moderate	Slight	White oak----------	50	Silver maple, green ash, white oak, hackberry, northern red oak.
						Northern red oak----	50	
						Black oak----------	---	
424E2*: Lindley----------	5r	Moderate	Moderate	Moderate	Slight	Black oak----------	50	White oak, green ash, black oak.
						Bur oak----------	---	
						Shingle oak----------	---	
Keswick----------	4c	Slight	Slight	Moderate	Slight	White oak----------	55	Eastern white pine, white oak, red pine, sugar maple, northern red oak, white ash.
						Northern red oak----	55	
						Black oak----------	---	
425C, 425D, 425D2-- Keswick	4c	Slight	Slight	Moderate	Slight	White oak----------	55	Eastern white pine, white oak, northern red oak, red pine, sugar maple, white ash.
						Northern red oak----	55	
						Black oak----------	---	
452C--------- Lineville	4o	Slight	Slight	Slight	Slight	White oak----------	55	Eastern white pine, white oak, red pine, Norway spruce, white spruce, sugar maple, green ash.
						Black oak----------	---	

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
478G*: Gosport	5c	Moderate	Moderate	Severe	Slight	White oak Black oak	45 ---	Eastern white pine, white oak, red pine, Norway spruce, Scotch pine, white spruce, cottonwood, green ash.
Rock outcrop.								
594C2, 594D2--- Galland	3c	Slight	Slight	Severe	Moderate	White oak Northern red oak	65 70	Eastern white pine, white oak, red pine, black walnut, sugar maple, northern red oak, white ash, hackberry.
688--- Koszta	3o	Slight	Slight	Slight	Moderate	White oak Northern red oak	65 70	Eastern white pine, red pine, white oak, northern red oak, sugar maple, black walnut.
731C2, 731D2--- Pershing	4c	Slight	Slight	Severe	Slight	White oak Northern red oak Shagbark hickory	55 --- ---	Eastern white pine, white oak, red pine, green ash.
732C2, 732D2--- Weller	4c	Slight	Slight	Severe	Slight	White oak Shagbark hickory Northern red oak Black oak	55 --- --- ---	Eastern white pine, white oak, red pine, black walnut, sugar maple, white ash, green ash.
792C2, 792D2--- Armstrong	4c	Slight	Slight	Severe	Slight	White oak Northern red oak	55 55	Eastern white pine, white oak, northern red oak, red pine, sugar maple, green ash, Scotch pine.
795D--- Ashgrove	5w	Slight	Severe	Moderate	Severe	White oak Northern red oak	45 45	Silver maple, green ash, white oak, northern red oak, hackberry.
832C2--- Weller	4c	Slight	Slight	Severe	Slight	White oak Black oak Shagbark hickory	55 --- ---	Eastern white pine, white oak, red pine, black walnut, sugar maple, white ash, white ash, green ash.
876B, 876C2--- Ladoga	2o	Slight	Slight	Slight	Moderate	White oak Northern red oak	75 75	Eastern white pine, red pine, white oak, sugar maple, northern red oak, black walnut.
993D2*: Gara	3o	Slight	Slight	Slight	Slight	White oak Northern red oak Shagbark hickory Black oak	55 55 --- ---	Eastern white pine, red pine, white oak, northern red oak, white ash.
Armstrong	4c	Slight	Slight	Severe	Slight	White oak Northern red oak	55 55	Eastern white pine, white oak, northern red oak, red pine, sugar maple, white ash.

See footnote at end of table.

TABLE 8.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	
993E2*:								
Gara	3r	Moderate	Moderate	Slight	Slight	White oak Northern red oak Shagbark hickory Black oak	55 55 --- ---	Eastern white pine, red pine, white oak, northern red oak, white ash, green ash.
Armstrong	4c	Moderate	Moderate	Severe	Slight	White oak Northern red oak Shagbark hickory Black oak	55 55 --- ---	Eastern white pine, white oak, northern red oak, red pine, sugar maple, white ash.
1130 Belinda	5w	Slight	Severe	Moderate	Severe	White oak Bur oak	45 ---	Eastern cottonwood, white oak, silver maple, green ash, northern white-cedar.
1131C Pershing	4c	Slight	Slight	Severe	Slight	White oak Shagbark hickory	55 ---	Eastern white pine, white oak, red pine, white ash.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
11B*:					
Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	---
Ely	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce	Eastern white pine.
13B*:					
Olmitz	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, northern white-cedar, blue spruce, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
Vesser	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
23C, 23C2---------- Arispe	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
24D2, 24E2--------- Shelby	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
41D---------- Sparta	Siberian peashrub	Eastern redcedar, radiant crabapple, Washington hawthorn, autumn-olive, Amur honeysuckle, lilac, Tatarian honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
51---------- Vesser	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
54, 54+---------- Zook	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern white-cedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
58D2, 58E2--------- Douds	---	Silky dogwood, Amur privet, American cranberrybush, Amur honeysuckle.	Blue spruce, white fir, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
65D, 65E, 65E2, 65G---------- Lindley	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
76B, 76C, 76C2, 76D, 76D2--------- Ladoga	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
80D, 80D2--------- Clinton	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
130---------- Belinda	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Norway spruce, blue spruce, northern white-cedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
131B, 131C--------- Pershing	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood, American cranberrybush.	Austrian pine, osageorange, green ash.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
132B, 132C-------- Weller	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
133---------- Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
133B---------- Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, white fir, blue spruce, Washington hawthorn, northern white-cedar.	Eastern white pine	Pin oak.
133+---------- Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
179D2, 179E2, 179F, 179F2------ Gara	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern white-cedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
192D2---------- Adair	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
211---------- Edina	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, northern white-cedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
220---------- Nodaway	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
222C, 222C2, 222D2---------- Clarinda	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Green ash, osageorange.	Eastern white pine, pin oak, Austrian pine.	---
223C2, 223D2------ Rinda	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur privet, American cranberrybush, Tatarian honeysuckle, Amur honeysuckle.	Green ash, Austrian pine, osageorange.	Eastern white pine, pin oak.	---
260---------- Beckwith	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
263---------- Okaw	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern white-cedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
273C---------- Olmitz	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
279---------- Taintor	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Washington hawthorn, northern white-cedar, Norway spruce, blue spruce, white fir.	Eastern white pine	Pin oak.
280---------- Mahaska	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, eastern white pine, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
281B, 281C, 281C2- Otley	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
313D, 313D2, 313E, 313E2, 313F------ Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
362---------- Haig	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern white-cedar, Washington hawthorn.	Eastern white pine	Pin oak.
364B---------- Grundy	---	Washington hawthorn, Tatarian honeysuckle, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, eastern redcedar.	Austrian pine, osageorange, green ash.	Pin oak, eastern white pine.	---
419D2, 419E2------ Vanmeter	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, osageorange, Russian-olive, Washington hawthorn.	Northern catalpa, honeylocust, green ash.	---	---
423D2---------- Bucknell	---	Tatarian honeysuckle, eastern redcedar, arrowwood, Washington hawthorn, Amur privet, Amur honeysuckle, American cranberrybush.	Green ash, Austrian pine, osageorange.	Eastern white pine, pin oak.	---
424E2*: Lindley----------	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Northern white-cedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
Keswick----------	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
425C, 425D, 425D2-- Keswick	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
428B---------- Ely	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
452C---------- Lineville	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, osageorange, green ash.	Eastern white pine, pin oak.	---
478G*: Gosport----------	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
Rock outcrop.					
484---------- Lawson	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
594C2, 594D2------ Galland	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
688---------- Koszta	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern white-cedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
731C2, 731D2---- Pershing	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood, American cranberrybush.	Austrian pine, osageorange, green ash.	Eastern white pine, pin oak.	---
732C2, 732D2---- Weller	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
792C2, 792D2---- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Tatarian honeysuckle, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
795D---------- Ashgrove	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
822D2---------- Lamoni	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur honeysuckle, Amur privet, Tatarian honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
832C2---------- Weller	---	American cranberrybush, Tatarian honeysuckle, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Pin oak, eastern white pine.	---
876B, 876C2---- Ladoga	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern white-cedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
993D2*, 993E2*: Gara	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern white-cedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Tatarian honeysuckle, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, osageorange.	Eastern white pine, pin oak.	---
1130 Belinda	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Norway spruce, blue spruce, northern white-cedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
1131C Pershing	---	Eastern redcedar, Tatarian honeysuckle, Washington hawthorn, Amur privet, Amur honeysuckle, arrowwood, American cranberrybush.	Austrian pine, osageorange, green ash.	Eastern white pine, pin oak.	---
1279 Taintor	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Washington hawthorn, northern white-cedar, Norway spruce, blue spruce, white fir.	Eastern white pine	Pin oak.
5020*: Pits.					
Dumps.					
5021*. Orthents					
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
11B*: Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
13B*: Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Vesser	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
23C, 23C2 Arispe	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
24D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
41D Sparta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
51 Vesser	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
54, 54+ Zook	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
58D2 Douds	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
58E2 Douds	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65D Lindley	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
65E, 65E2 Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
65G Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
76B Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
76C, 76C2---------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
76D, 76D2---------- Ladoga	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
80D, 80D2---------- Clinton	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
130---------- Belinda	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
131B---------- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.
131C---------- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
132B---------- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.
132C---------- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
133---------- Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
133B---------- Colo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
133+---------- Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
179D2---------- Gara	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
179E2, 179F, 179F2---- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
192D2---------- Adair	Severe: wetness.	Moderate: wetness, slope, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
211---------- Edina	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
220---------- Nodaway	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
222C, 222C2---------- Clarinda	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
222D2--- Clarinda	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness, slope.
223C2--- Rinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
223D2--- Rinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness, slope.
260--- Beckwith	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
263--- Okaw	Severe: flooding, ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
273C--- Olmitz	Slight---	Slight---	Severe: slope.	Slight---	Slight.
279--- Taintor	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
280--- Mahaska	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight---	Slight.
281B--- Otley	Slight---	Slight---	Moderate: slope.	Slight---	Slight.
281C, 281C2--- Otley	Slight---	Slight---	Severe: slope.	Slight---	Slight.
313D, 313D2--- Gosport	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope, thin layer.
313E, 313E2--- Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
313F--- Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, erodes easily.	Severe: slope.
362--- Haig	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
364B--- Grundy	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
419D2--- Vanmeter	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope, thin layer.
419E2--- Vanmeter	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
423D2---------- Bucknell	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, slope.
424E2*: Lindley----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Keswick----------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
425C---------- Keswick	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
425D, 425D2---------- Keswick	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
428B---------- Ely	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight----------	Slight.
452C---------- Lineville	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
478G*: Gosport----------	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, erodes easily.	Severe: slope.
Rock outcrop.					
484---------- Lawson	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: flooding, wetness.
594C2---------- Galland	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
594D2---------- Galland	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
688---------- Koszta	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Slight----------	Slight.
731C2---------- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
731D2---------- Pershing	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
732C2---------- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
732D2---------- Weller	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
792C2---------- Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
792D2---------- Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
795D---------- Ashgrove	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness, slope.
822D2---------- Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
832C2---------- Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
876B---------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
876C2---------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
993D2*: Gara----------	Moderate: percs slowly, slope.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
Armstrong----------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
993E2*: Gara----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Armstrong----------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: slope, wetness.
1130---------- Belinda	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
1131C---------- Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight----------	Slight.
1279---------- Taintor	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
5020*: Pits.					

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
5020*: Dumps.					
5021*. Orthents					
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT POTENTIALS

[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 herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
11B*:										
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
13B*:										
Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Vesser	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
23C, 23C2--- Arispe	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Very poor.
24D2--- Shelby	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24E2--- Shelby	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
41D--- Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
51--- Vesser	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
54, 54+--- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
58D2--- Douds	Fair	Good	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
58E2--- Douds	Very poor.	Good	Fair	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
65D--- Lindley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
65E, 65E2--- Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
65G--- Lindley	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
76B--- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
76C, 76C2, 76D, 76D2--- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
80D, 80D2--- Clinton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
130--- Belinda	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
131B--- Pershing	Good	Good	Fair	Good	Good	Poor	Poor	Good	Fair	Poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
131C---------- Pershing	Fair	Fair	Fair	Good	Good	Very poor.	Poor	Fair	Fair	Very poor.
132B---------- Weller	Good	Good	Fair	Good	Good	Poor	Poor	Good	Fair	Poor.
132C---------- Weller	Fair	Fair	Fair	Good	Good	Very poor.	Poor	Fair	Fair	Very poor.
133---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
133B---------- Colo	Good	Fair	Good	Fair	Poor	Fair	Very poor.	Fair	Fair	Good.
133+---------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
179D2---------- Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
179E2, 179F, 179F2- Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
192D2---------- Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
211---------- Edina	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
220---------- Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
222C, 222C2, 222D2- Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
223C2, 223D2------- Rinda	Poor	Fair	Poor	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
260---------- Beckwith	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
263---------- Okaw	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
273C---------- Olmitz	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
279---------- Taintor	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
280---------- Mahaska	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
281B---------- Otley	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
281C, 281C2-------- Otley	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
313D, 313D2, 313E, 313E2, 313F------- Gosport	Very poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
362---------- Haig	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
364B---------- Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
419D2, 419E2------- Vanmeter	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
423D2---------- Bucknell	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Very poor.
424E2*: Lindley----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Keswick----------	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
425C, 425D, 425D2-- Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
428B---------- Ely	Good	Good	Good	Good	Good	Fair	Very poor.	Good	Good	Poor.
452C---------- Lineville	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
478G*: Gosport----------	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Rock outcrop.										
484---------- Lawson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
594C2, 594D2------- Galland	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
688---------- Koszta	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
731C2---------- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
731D2---------- Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
732C2, 732D2------- Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
792C2, 792D2------- Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
795D---------- Ashgrove	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
822D2---------- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
832C2---------- Weller	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
876B---------- Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
876C2---------- Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
993D2*: Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
993E2*: Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
1130 Belinda	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
1131C Pershing	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
1279 Taintor	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
5020*: Pits.										
Dumps.										
5021*. Orthents										
5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
11B*:						
Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
13B*:						
Olmitz	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
Vesser	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
23C, 23C2 Arispe	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
24D2 Shelby	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
24E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
41D Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
51 Vesser	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
54, 54+ Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
58D2 Douds	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: wetness, slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
58E2 Douds	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
65D Lindley	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.

See footnote at end of table.

TABLE 12.--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
65E, 65E2, 65G---- Lindley	Severe: slope.	Severe: slope.	Severe: slope	Severe: slope.	Severe: low strength, slope.	Severe: slope.
76B---------- Ladoga	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
76C, 76C2--------- Ladoga	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
76D, 76D2--------- Ladoga	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
80D, 80D2--------- Clinton	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
130---------- Belinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
131B, 131C-------- Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
132B, 132C-------- Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
133---------- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
133B---------- Colo	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
133+---------- Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
179D2---------- Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
179E2, 179F, 179F2---------- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
192D2---------- Adair	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
211---------- Edina	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.

See footnote at end of table.

TABLE 12.--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
220---------- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
222C, 222C2------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness.
222D2---------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness, slope.
223C2---------- Rinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness.
223D2---------- Rinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: frost action, low strength, shrink-swell.	Moderate: wetness, slope.
260---------- Beckwith	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding.
263---------- Okaw	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding.	Severe: ponding.
273C---------- Olmitz	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
279---------- Taintor	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
280---------- Mahaska	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: wetness.	Moderate: shrink-swell, wetness.	Severe: low strength, frost action.	Slight.
281B---------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
281C, 281C2------- Otley	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
313D, 313D2------- Gosport	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope, thin layer.
313E, 313E2, 313F- Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
362---------- Haig	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.

See footnote at end of table.

TABLE 12.--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
364B---------- Grundy	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
419D2---------- Vanmeter	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope, thin layer.
419E2---------- Vanmeter	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
423D2---------- Bucknell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.
424E2*: Lindley----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Keswick----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
425C---------- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action.	Moderate: wetness.
425D, 425D2------- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness, slope.
428B---------- Ely	Severe: wetness.	Severe: low strength.	Severe: low strength, wetness.	Severe: low strength.	Severe: frost action, low strength.	Slight.
452C---------- Lineville	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
478G*: Gosport----------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
Rock outcrop.						
484---------- Lawson	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: flooding, wetness.
594C2---------- Galland	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action.	Slight.
594D2---------- Galland	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, frost action.	Moderate: slope.

See footnote at end of table.

TABLE 12.--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
688--Koszta	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
731C2--Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
731D2--Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, frost action.	Moderate: slope.
732C2--Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
732D2--Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, frost action, low strength.	Moderate: slope.
792C2--Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: low strength, frost action.	Moderate: wetness.
792D2--Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
795D--Ashgrove	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness, slope.
822D2--Lamoni	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
832C2--Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
876B--Ladoga	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
876C2--Ladoga	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
993D2*:						
Gara	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
993E2*:						
Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

See footnote at end of table.

TABLE 12.--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
993E2*: Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness, slope.	Severe: low strength, frost action.	Moderate: slope, wetness.
1130 Belinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
1131C Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
1279 Taintor	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
5020*: Pits.						
Dumps.						
5021*. Orthents						
5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "fair," "poor," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11B*:					
Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
13B*:					
Olmitz	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
Vesser	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
23C, 23C2--- Arispe	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
24D2--- Shelby	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
24E2--- Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
41D--- Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
51--- Vesser	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
54, 54+--- Zook	Severe: percs slowly, wetness, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: too clayey, wetness, hard to pack.
58D2--- Douds	Moderate: wetness, percs slowly, slope.	Severe: seepage, slope.	Severe: seepage, wetness.	Severe: seepage.	Fair: too clayey, too sandy, slope.
58E2--- Douds	Severe: slope.	Severe: seepage, slope.	Severe: seepage, wetness, slope.	Severe: seepage, slope.	Poor: slope.
65D--- Lindley	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
65E, 65E2, 65G--- Lindley	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 13.--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
76B---------- Ladoga	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76C, 76C2---------- Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
76D, 76D2---------- Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
80D, 80D2---------- Clinton	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
130---------- Belinda	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
131B---------- Pershing	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
131C---------- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
132B---------- Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
132C---------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
133---------- Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
133B---------- Colo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
133+---------- Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
179D2---------- Gara	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
179E2, 179F, 179F2-- Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
192D2---------- Adair	Severe: percs slowly, wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
211---------- Edina	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack wetness.
220---------- Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.

See footnote at end of table.

TABLE 13.--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
222C, 222C2, 222D2-- Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
223C2, 223D2-------- Rinda	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.
260---------- Beckwith	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
263---------- Okaw	Severe: ponding, percs slowly.	Slight----------	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
273C---------- Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
279---------- Taintor	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
280---------- Mahaska	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
281B---------- Otley	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
281C, 281C2--------- Otley	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
313D, 313D2--------- Gosport	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
313E, 313E2, 313F--- Gosport	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, hard to pack, slope.
362---------- Haig	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
364B---------- Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
419D2---------- Vanmeter	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
419E2---------- Vanmeter	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, hard to pack, slope.

See footnote at end of table.

TABLE 13.--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
423D2---------- Bucknell	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
424E2*: Lindley----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Keswick----------	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
425C, 425D, 425D2--- Keswick	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
428B---------- Ely	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
452C---------- Lineville	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
478G*: Gosport----------	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, hard to pack, slope.
Rock outcrop.					
484---------- Lawson	Severe: flooding, wetness.	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
594C2---------- Galland	Severe: wetness, percs slowly.	Severe: slope.	Severe: seepage, too clayey.	Slight----------	Poor: too clayey, hard to pack.
594D2---------- Galland	Severe: wetness, percs slowly.	Severe: slope.	Severe: seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
688---------- Koszta	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
731C2, 731D2-------- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
732C2, 732D2-------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
792C2, 792D2-------- Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
795D---------- Ashgrove	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 13.--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
822D2---------- Lamoni	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
832C2---------- Weller	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
876B---------- Ladoga	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
876C2---------- Ladoga	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
993D2*: Gara----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
Armstrong----------	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
993E2*: Gara----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Armstrong----------	Severe: slope, percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey, slope.	Severe: wetness, slope.	Poor: too clayey, hard to pack, slope.
1130---------- Belinda	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1131C---------- Pershing	Severe: percs slowly, wetness.	Severe: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey.
1279---------- Taintor	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
5020*: Pits.					
Dumps.					
5021*. Orthents					
5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
11B*:				
Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
13B*:				
Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
23C, 23C2 Arispe	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
24D2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
24E2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
41D Sparta	Good	Probable	Improbable: too sandy.	Fair: slope, too sandy.
51 Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54 Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
54+ Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
58D2 Douds	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
58E2 Douds	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
65D Lindley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
65E, 65E2 Lindley	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
65G Lindley	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
76B, 76C, 76C2, 76D, 76D2---- Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
80D, 80D2---- Clinton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
130---- Belinda	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
131B, 131C---- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
132B, 132C---- Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
133---- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
133B---- Colo	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
133+---- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
179D2---- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
179E2, 179F, 179F2---- Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
192D2---- Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
211---- Edina	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
220---- Nodaway	Good----	Improbable: excess fines.	Improbable: excess fines.	Good.
222C, 222C2, 222D2---- Clarinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer, too clayey.
223C2, 223D2---- Rinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
260---- Beckwith	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
263---- Okaw	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
273C---------- Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
279---------- Taintor	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
280---------- Mahaska	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
281B, 281C, 281C2----- Otley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
313D, 313D2---------- Gosport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
313E, 313E2---------- Gosport	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
313F---------- Gosport	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
362---------- Haig	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
364B---------- Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
419D2---------- Vanmeter	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
419E2---------- Vanmeter	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
423D2---------- Bucknell	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
424E2*: Lindley----------	Fair: slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Keswick----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
425C, 425D, 425D2----- Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
428B---------- Ely	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
452C---------- Lineville	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
478G*: Gosport	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Rock outcrop.				
484 Lawson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
594C2, 594D2 Galland	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
688 Koszta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
731C2 Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
731D2 Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
732C2, 732D2 Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
792C2, 792D2 Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
795D Ashgrove	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
822D2 Lamoni	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
832C2 Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
876B, 876C2 Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
993D2*: Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
993E2*: Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1130 Belinda	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1131C---------- Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
1279---------- Taintor	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
5020*: Pits.				
Dumps.				
5021*. Orthents				
5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

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
11B*:							
Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
Ely	Moderate: slope, seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
13B*:							
Olmitz	Moderate: seepage, slope.	Slight	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
Vesser	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness, erodes easily.	Erodes easily, wetness.
23C, 23C2---- Arispe	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Severe: no water.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.
24D2, 24E2---- Shelby	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope	Slope.
41D---- Sparta	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
51---- Vesser	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness, erodes easily.	Erodes easily, wetness.
54, 54+---- Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Flooding, percs slowly, frost action.	Wetness, percs slowly.	Not needed	Not needed.
58D2, 58E2---- Douds	Severe: seepage, slope.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Slope	Slope, too sandy.	Slope.
65D, 65E, 65E2, 65G---- Lindley	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Slope	Slope.
76B, 76C, 76C2---- Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 15.--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
76D, 76D2--------- Ladoga	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
80D, 80D2--------- Clinton	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
130--------------- Belinda	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
131B, 131C-------- Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
132B, 132C-------- Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
133--------------- Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness--------	Wetness.
133B-------------- Colo	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Frost action, slope.	Wetness, slope.	Wetness--------	Wetness.
133+-------------- Colo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness--------	Wetness.
179D2, 179E2, 179F, 179F2------ Gara	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
192D2------------- Adair	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope, frost action.	Wetness, percs slowly, slope.	Slope, wetness.	Wetness, slope.
211--------------- Edina	Slight---------	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly---	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
220--------------- Nodaway	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Flooding, erodes easily.	Erodes easily	Erodes easily.
222C, 222C2------- Clarinda	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
222D2------------- Clarinda	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Wetness, slope, erodes easily.

See footnote at end of table.

TABLE 15.--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
223C2--------- Rinda	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, wetness.
223D2--------- Rinda	Severe: slope.	Severe: hard to pack.	Severe: no water.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Wetness, slope, erodes easily.
260--------- Beckwith	Slight---------	Severe: ponding.	Severe: no water.	Ponding, percs slowly.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
263--------- Okaw	Slight---------	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
273C--------- Olmitz	Moderate: seepage, slope.	Slight--- ------	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
279--------- Taintor	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
280--------- Mahaska	Moderate: seepage.	Moderate: wetness, hard to pack.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
281B, 281C, 281C2- Otley	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
313D, 313D2, 313E, 313E2, 313F------ Gosport	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Percs slowly, depth to rock, rooting depth.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
362--------- Haig	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
364B--------- Grundy	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
419D2, 419E2------ Vanmeter	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Percs slowly, depth to rock, rooting depth.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
423D2--------- Bucknell	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, rooting depth.	Slope, wetness, percs slowly.	Wetness, slope, rooting depth.

See footnote at end of table.

TABLE 15.--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
424E2*:							
Lindley	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Slope	Slope.
Keswick	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
425C Keswick	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Wetness, erodes easily.
425D, 425D2 Keswick	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
428B Ely	Moderate: slope, seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Slope, frost action.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
452C Lineville	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Wetness, erodes easily.
478G*:							
Gosport	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Percs slowly, depth to rock, rooting depth.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Rock outcrop.							
484 Lawson	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
594C2 Galland	Moderate: seepage, slope.	Moderate: hard to pack, thin layer.	Severe: no water.	Deep to water	Percs slowly, rooting depth, slope.	Erodes easily, percs slowly.	Erodes easily, rooting depth.
594D2 Galland	Severe: slope.	Moderate: hard to pack, thin layer.	Severe: no water.	Deep to water	Percs slowly, rooting depth, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, rooting depth.
688 Koszta	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
731C2 Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
731D2 Pershing	Severe: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 15.--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
732C2--------- Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
732D2--------- Weller	Severe: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Slope, wetness, erodes easily.	Slope, percs slowly, erodes easily.
792C2--------- Armstrong	Moderate: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Percs slowly, wetness.	Percs slowly, wetness.
792D2--------- Armstrong	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
795D--------- Ashgrove	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
822D2--------- Lamoni	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.
832C2--------- Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
876B, 876C2------- Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
993D2*, 993E2*: Gara---------	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
Armstrong--------	Severe: slope.	Moderate: wetness, hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Slope, percs slowly, wetness.	Percs slowly, slope, wetness.
1130--------- Belinda	Slight---------	Severe: wetness.	Severe: slow refill.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
1131C--------- Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Erodes easily, percs slowly.
1279--------- Taintor	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Wetness, erodes easily.
5020*: Pits.							

See footnote at end of table.

TABLE 15.--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
5020*: Dumps.							
5021*. Orthents							
5030*. Pits							
5040*. Orthents							

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11B*:											
Colo	0-7	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	7-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Ely	0-25	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	25-47	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	47-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
13B*:											
Olmitz	0-29	Loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	29-60	Clay loam	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
Colo	0-7	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	7-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
Vesser	0-13	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	13-31	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	31-60	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
23C	0-10	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
Arispe	10-46	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-60	25-35
	46-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
23C2	0-7	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
Arispe	7-39	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-60	25-35
	39-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
24D2, 24E2	0-7	Clay loam	CL	A-6, A-7	0	90-95	85-95	75-90	55-70	35-45	15-25
Shelby	7-39	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	39-60	Clay loam	CL	A-6, A-7	0-5	90-95	85-95	75-90	55-70	30-45	15-25
41D	0-16	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
Sparta	16-35	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
	35-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	85-100	85-100	50-95	2-30	---	NP
51	0-13	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
Vesser	13-31	Silt loam	CL	A-6	0	100	100	98-100	95-100	30-40	10-20
	31-60	Silty clay loam	CL	A-7	0	100	100	98-100	95-100	40-50	15-25
54	0-15	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	15-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
54+	0-18	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Zook	18-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
58D2, 58E2------- Douds	0-6	Loam----------	CL	A-6	0	95-100	85-100	70-90	60-80	25-35	10-20
	6-28	Clay loam, loam, sandy clay loam.	CL, SC	A-6, A-7	0	90-100	85-100	70-80	35-60	30-45	15-25
	28-60	Stratified loamy sand to clay loam.	SC, CL, SM-SC, CL-ML	A-4, A-6, A-2	0	90-100	85-100	65-85	20-60	15-35	5-15
65D, 65E, 65E2, 65G---------- Lindley	0-9	Loam----------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	9-50	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	50-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
76B, 76C, 76C2, 76D, 76D2------- Ladoga	0-8	Silt loam---------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	8-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	50-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
80D---------- Clinton	0-13	Silt loam---------	ML	A-4	0	100	100	100	95-100	30-40	5-10
	13-46	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	46-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
80D2---------- Clinton	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
	6-37	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	37-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	95-100	35-45	15-25
130---------- Belinda	0-6	Silt loam---------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	6-20	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4	0	100	100	100	95-100	25-35	5-10
	20-41	Silty clay--------	CH	A-7	0	100	100	100	95-100	55-70	30-40
	41-60	Silty clay loam	CH	A-7	0	100	100	100	95-100	50-65	25-35
131B, 131C------- Pershing	0-9	Silt loam---------	CL	A-6	0	100	100	100	95-100	30-40	10-20
	9-13	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	13-37	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	37-72	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
132B, 132C------- Weller	0-15	Silt loam---------	ML-CL, CL	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	15-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
133, 133B-------- Colo	0-7	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	7-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
133+---------- Colo	0-10	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	10-38	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	38-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
179D2, 179E2, 179F, 179F2----- Gara	0-6	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	6-47	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	47-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
192D2---------- Adair	0-6	Clay loam--------	CL	A-6	0	95-100	80-95	75-90	60-80	30-40	10-20
	6-40	Silty clay, clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	80-95	70-90	55-80	40-55	20-30
	40-60	Clay loam--------	CL	A-6, A-7	0	95-100	80-95	70-90	55-80	35-50	15-25
211---------- Edina	0-17	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
	17-48	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	55-75	30-45
	48-60	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-60	15-35
220---------- Nodaway	0-60	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
222C, 222C2, 222D2---------- Clarinda	0-12	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	12-25	Silty clay, clay	CH	A-7	0	100	95-100	85-100	80-100	55-70	30-40
	25-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
223C2, 223D2----- Rinda	0-7	Silty clay loam	CL	A-7	0	100	95-100	90-100	85-100	40-50	20-30
	7-11	Silty clay loam	CL, CH	A-7	0	100	95-100	90-100	85-100	45-55	20-30
	11-60	Clay, silty clay	CH	A-7	0	95-100	95-100	80-95	75-90	55-70	35-45
260---------- Beckwith	0-6	Silt loam--------	CL, ML, CL-ML	A-4	0	100	100	100	95-100	25-35	5-10
	6-13	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	13-46	Silty clay-------	CH	A-7	0	100	100	100	95-100	55-70	30-40
	46-60	Silty clay loam	CH	A-7	0	100	100	100	95-100	50-65	25-35
263---------- Okaw	0-14	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	14-48	Silty clay, clay, silty clay loam.	CH	A-7	0	100	95-100	95-100	85-100	50-70	30-50
	48-60	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	100	100	95-100	80-100	45-65	20-40
273C---------- Olmitz	0-29	Loam, clay loam	CL	A-6	0	100	90-100	85-95	60-80	30-40	11-20
	29-60	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-95	60-80	35-45	15-25
279---------- Taintor	0-18	Silt loam, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
	18-52	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	52-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	15-25
280---------- Mahaska	0-19	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	19-50	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-60	20-30
	50-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	15-20
281B, 281C, 281C2---------- Otley	0-16	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	16-48	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	48-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-45	20-30
313D, 313D2, 313E, 313E2, 313F---------- Gosport	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
	9-30	Clay, silty clay	CH	A-7	0	100	100	95-100	85-100	50-65	35-50
	30-60	Weathered bedrock	CH	A-7	0	100	100	95-100	85-100	65-80	50-60

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
362---------- Haig	0-7	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	100	95-100	40-55	15-25
	7-17	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	20-30
	17-41	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-65	30-40
	41-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-55	20-30
364B---------- Grundy	0-12	Silty clay loam	CH, CL	A-7	0	100	100	95-100	90-100	40-55	20-35
	12-16	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	25-35
	16-42	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	42-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
419D2, 419E2----- Vanmeter	0-6	Silty clay loam	ML, MH, CH	A-7	0-5	95-100	75-100	70-100	65-100	40-55	11-25
	6-25	Silty clay, clay	CH, CL	A-7	0-5	95-100	75-100	70-100	65-100	40-65	24-40
	25-60	Weathered bedrock	CH	A-7	0-5	95-100	90-100	90-100	85-100	65-80	50-60
423D2---------- Bucknell	0-7	Silty clay loam	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	7-52	Clay, clay loam	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	52-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
424E2*: Lindley---------	0-4	Loam----------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	4-39	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	12-20
	39-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
Keswick---------	0-6	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	6-28	Clay loam, clay	CH, MH	A-7	0-5	90-100	80-100	70-90	55-80	50-60	20-30
	28-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
425C, 425D, 425D2---------- Keswick	0-10	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	10-32	Clay loam, clay	CH, MH	A-7	0-5	90-100	80-100	70-90	55-80	50-60	20-30
	32-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
428B---------- Ely	0-25	Silty clay loam	CL, OL, OH, MH	A-7, A-6	0	100	100	95-100	95-100	30-55	10-25
	25-47	Silty clay loam	CL, ML	A-7, A-6	0	100	100	95-100	95-100	35-50	10-25
	47-60	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	90-100	85-100	25-40	10-20
452C---------- Lineville	0-11	Silt loam--------	CL, ML	A-6, A-7	0	100	100	95-100	95-100	35-45	10-20
	11-14	Silty clay loam	CL, CH	A-7	0	100	100	95-100	95-100	45-55	25-35
	14-35	Clay loam, loam	CL	A-6, A-7	0	95-100	80-100	75-95	65-90	35-50	20-35
	35-60	Clay loam, clay	CH, CL	A-7	0-5	95-100	80-100	70-90	55-80	45-60	25-35
478G*: Gosport---------	0-9	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-100	25-40	5-15
	9-30	Clay, silty clay	CH	A-7	0	100	100	95-100	85-100	50-65	35-50
	30-60	Weathered bedrock	CH	A-7	0	100	100	95-100	85-100	65-80	50-60
Rock outcrop.											
484---------- Lawson	0-35	Silt loam--------	CL, CL-ML	A-4	0	100	100	90-100	80-100	20-30	5-10
	35-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	90-100	80-100	20-40	10-25
594C2, 594D2----- Galland	0-5	Loam----------	CL	A-6	0	90-100	80-100	75-100	65-90	30-40	10-20
	5-43	Clay loam, clay, silty clay.	CL, CH	A-7	0-5	90-100	80-100	75-100	65-80	40-55	25-35
	43-60	Stratified sandy loam to clay.	SM-SC, SC, CL-ML, CL	A-4, A-2, A-6	0-5	90-100	80-100	65-95	30-60	20-35	5-15
688---------- Koszta	0-14	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20
	14-60	Silty clay loam	CL	A-7	0	100	100	95-100	95-100	40-50	20-30

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
731C2, 731D2----- Pershing	0-6	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	6-51	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	51-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
732C2, 732D2----- Weller	0-6	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	6-26	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	26-60	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	40-55	20-30
792C2, 792D2----- Armstrong	0-5	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20--30	5-15
	5-25	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	90-100	80-95	70-90	55-80	45-60	20-30
	25-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
795D---------- Ashgrove	0-10	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	95-100	90-100	85-100	20-30	5-15
	10-60	Clay, silty clay	CH	A-7	0	95-100	95-100	75-90	75-90	50-60	25-35
822D2---------- Lamoni	0-14	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	80-95	70-95	35-45	15-25
	14-46	Clay loam, clay	CH	A-7	0	95-100	95-100	90-100	85-100	50-60	25-35
	46-60	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	70-90	55-85	35-50	15-30
832C2---------- Weller	0-6	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	6-26	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	26-60	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	40-55	20-30
876B, 876C2------ Ladoga	0-11	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	11-54	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	54-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
993D2*, 993E2*:											
Gara----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0	95-100	85-95	75-85	55-70	20-30	5-15
	8-54	Clay loam, loam	CL	A-6	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	54-60	Loam, clay loam	CL	A-6, A-7	0-5	90-95	85-95	70-85	55-75	35-45	15-25
Armstrong-------	0-5	Loam----------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	5-25	Clay loam, clay, silty clay loam.	CL, CH	A-7	0-5	90-100	80-95	70-90	55-80	45-60	20-30
	25-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
1130---------- Belinda	0-6	Silt loam--------	CL, ML	A-4, A-6	0	100	100	100	95-100	30-40	5-15
	6-18	Silt loam--------	CL-ML, CL, ML	A-4	0	100	100	100	95-100	25-35	5-10
	18-41	Silty clay-------	CH	A-7	0	100	100	100	95-100	55-70	30-40
	41-60	Silty clay loam	CH	A-7	0	100	100	100	95-100	50-65	25-35
1131C---------- Pershing	0-9	Silt loam--------	CL	A-6	0	100	100	100	95-100	30-40	10-20
	9-13	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	40-55	15-30
	13-37	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-65	20-40
	37-72	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	35-55	20-35
1279---------- Taintor	0-18	Silt loam, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
	18-52	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	95-100	50-65	25-35
	52-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	100	95-100	40-50	15-25
5020*: Pits.											

See footnote at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
5020*: Dumps.											
5021*. Orthents											
5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" 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	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
11B*:											
Colo	0-7	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7	5-7
	7-36	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High	0.28			
	36-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28			
Ely	0-25	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate	0.32	5	7	4-6
	25-47	28-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate	0.43			
	47-60	20-30	1.40-1.45	0.6-2.0	0.18-0.20	6.6-8.4	Moderate	0.43			
13B*:											
Olmitz	0-29	24-30	1.40-1.45	0.6-2.0	0.19-0.21	6.6-7.8	Moderate	0.28	5	6	3-4
	29-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	6.6-7.8	Moderate	0.28			
Colo	0-7	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High	0.28	5	7	5-7
	7-36	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High	0.28			
	36-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High	0.28			
Vesser	0-13	20-26	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	6	3-4
	13-31	18-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-6.0	Moderate	0.43			
	31-60	30-35	1.40-1.45	0.6-2.0	0.17-0.21	5.1-6.5	Moderate	0.43			
23C	0-10	28-35	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High	0.32	5	7	3-4
Arispe	10-46	35-42	1.35-1.45	0.2-0.6	0.18-0.20	5.1-7.3	High	0.43			
	46-60	24-35	1.40-1.50	0.6-2.0	0.18-0.20	6.6-7.3	High	0.43			
23C2	0-7	28-35	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High	0.32	5	7	2-4
Arispe	7-39	35-42	1.35-1.45	0.2-0.6	0.18-0.20	5.1-7.3	High	0.43			
	39-60	24-35	1.40-1.50	0.6-2.0	0.18-0.20	6.6-7.3	High	0.43			
24D2, 24E2	0-7	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28	4	6	.5-2
Shelby	7-39	30-35	1.55-1.75	0.2-0.6	0.16-0.18	5.1-7.3	Moderate	0.28			
	39-60	30-35	1.75-1.85	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37			
41D	0-16	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low	0.17	5	2	.5-1
Sparta	16-35	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-6.5	Low	0.17			
	35-60	0-5	1.50-1.70	6.0-20	0.04-0.07	5.1-6.0	Low	0.17			
51	0-13	20-26	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate	0.32	5	6	3-4
Vesser	13-31	18-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-7.3	Moderate	0.43			
	31-60	30-35	1.40-1.45	0.6-2.0	0.17-0.21	5.1-6.5	Moderate	0.43			
54	0-15	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High	0.28	5	7	5-7
Zook	15-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28			
54+	0-18	20-26	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	0.28	5	6	1-3
Zook	18-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High	0.28			
58D2, 58E2	0-6	20-27	1.45-1.50	0.6-2.0	0.15-0.17	5.1-7.3	Low	0.32	5-4	6	.5-1
Douds	6-28	26-35	1.45-1.65	0.6-2.0	0.15-0.17	4.5-6.0	Moderate	0.32			
	28-60	5-30	1.55-1.75	0.6-6.0	0.11-0.13	5.1-6.0	Low	0.32			
65D, 65E, 65E2, 65G	0-9	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low	0.32	5	6	<2
Lindley	9-50	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate	0.32			
	50-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	5.1-7.8	Moderate	0.32			
76B, 76C, 76C2, 76D, 76D2	0-8	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.32	5	6	.5-3
Ladoga	8-50	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Moderate	0.43			
	50-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
80D----------	0-13	16-26	1.30-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.37	5	6	.5-1
Clinton	13-46	36-42	1.35-1.45	0.2-0.6	0.16-0.20	4.5-6.0	Moderate-----	0.37			
	46-60	24-35	1.40-1.55	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.37			
80D2---------	0-6	27-34	1.30-1.40	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37	4	7	<.5
Clinton	6-37	36-42	1.35-1.45	0.2-0.6	0.16-0.20	4.5-6.0	Moderate-----	0.37			
	37-60	24-35	1.40-1.55	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.37			
130----------	0-6	16-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	4	6	2-3
Belinda	6-20	18-27	1.30-1.35	0.6-2.0	0.20-0.22	4.5-6.5	Low----------	0.37			
	20-41	32-52	1.30-1.45	<0.06	0.12-0.14	4.5-6.0	High---------	0.28			
	41-60	28-40	1.40-1.50	0.06-0.6	0.18-0.20	5.1-6.0	High---------	0.28			
131B, 131C-------	0-9	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	3-2	6	2-3
Pershing	9-13	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.37			
	13-37	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.37			
	37-72	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.37			
132B, 132C-------	0-15	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-2
Weller	15-60	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High---------	0.43			
133, 133B--------	0-7	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
Colo	7-36	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	36-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
133+---------	0-10	20-26	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.28	5	6	3-5
Colo	10-38	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	38-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
179D2, 179E2, 179F, 179F2-----	0-6	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	5	6	.5-2
Gara	6-47	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.28			
	47-60	24-38	1.75-1.85	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37			
192D2----------	0-6	27-35	1.45-1.50	0.2-0.6	0.17-0.19	5.6-7.3	Moderate-----	0.32	2	6	1-3
Adair	6-40	38-50	1.50-1.60	0.06-0.2	0.13-0.16	5.1-7.3	High---------	0.32			
	40-60	30-38	1.60-1.85	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32			
211----------	0-17	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.37	4	6	2-4
Edina	17-48	36-60	1.30-1.45	<0.2	0.11-0.13	5.6-7.3	Very high----	0.37			
	48-60	27-40	1.35-1.50	0.06-0.2	0.18-0.20	6.6-7.3	High---------	0.37			
220----------	0-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.37	5	6	2-3
Nodaway											
222C, 222C2, 222D2----------	0-12	30-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7	1-4
Clarinda	12-25	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-6.5	High---------	0.37			
	25-60	40-60	1.55-1.75	<0.06	0.14-0.16	5.6-7.3	High---------	0.37			
223C2, 223D2-----	0-7	27-35	1.45-1.50	0.2-0.6	0.20-0.22	5.6-7.3	Moderate-----	0.43	2	6	1-2
Rinda	7-11	30-40	1.45-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
	11-60	40-60	1.45-1.75	<0.06	0.14-0.16	5.1-7.3	High---------	0.32			
260----------	0-6	16-22	1.35-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	4	6	1-2
Beckwith	6-13	18-27	1.30-1.35	0.6-2.0	0.20-0.22	4.5-5.5	Low----------	0.37			
	13-46	40-52	1.30-1.45	<0.06	0.12-0.14	5.1-6.5	High---------	0.28			
	46-60	28-40	1.40-1.50	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.37			
263----------	0-14	15-27	1.20-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-3
Okaw	14-48	40-60	1.35-1.60	<0.06	0.09-0.18	3.6-6.0	High---------	0.32			
	48-60	35-60	1.45-1.70	<0.06	0.08-0.18	3.6-7.3	High---------	0.32			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
273C----------	0-29	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	3-4
Olmitz	29-60	28-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-6.5	Moderate-----	0.28			
279----------	0-18	25-36	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	3-5
Taintor	18-52	35-44	1.30-1.45	0.2-0.6	0.14-0.18	5.6-6.5	High----------	0.43			
	52-60	24-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43			
280----------	0-19	20-32	1.30-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	6	3-5
Mahaska	19-50	36-42	1.30-1.45	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.43			
	50-60	24-32	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
281B, 281C, 281C2----------	0-16	28-34	1.25-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7	2-4
Otley	16-48	36-42	1.30-1.40	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.43			
	48-60	24-35	1.35-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
313D, 313D2, 313E, 313E2, 313F----------	0-9	18-27	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Low----------	0.43	3	6	.5-2
Gosport	9-30	40-60	1.50-1.60	<0.06	0.12-0.14	3.6-6.0	High----------	0.32			
	30-60	40-75	1.70-1.90	<0.06	0.08-0.10	4.0-6.0	High----------	----			
362----------	0-7	32-40	1.35-1.40	0.6-2.0	0.21-0.23	5.6-7.3	High----------	0.37	5	7	3-4
Haig	7-17	28-48	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	High----------	0.37			
	17-41	40-50	1.30-1.45	<0.2	0.12-0.14	5.1-6.5	High----------	0.37			
	41-60	28-40	1.40-1.50	0.2-0.6	0.18-0.20	6.1-7.3	High----------	0.37			
364B----------	0-12	28-35	1.35-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High----------	0.37	3	6	3-4
Grundy	12-16	32-45	1.35-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High----------	0.37			
	16-42	40-50	1.30-1.40	0.06-0.2	0.11-0.13	5.1-7.3	High----------	0.37			
	42-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High----------	0.37			
419D2, 419E2-----	0-6	27-34	1.30-1.40	0.2-0.6	0.14-0.16	6.1-8.4	Moderate-----	0.43	2	6	.5-2
Vanmeter	6-25	40-60	1.50-1.60	<0.06	0.12-0.14	6.1-8.4	High----------	0.32			
	25-60	40-75	1.70-1.90	<0.06	0.08-0.10	7.4-8.4	High----------	----			
423D2----------	0-7	27-38	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.32	2	7	.5-2
Bucknell	7-52	38-50	1.55-1.75	<0.2	0.13-0.17	4.5-6.0	High----------	0.32			
	52-60	30-40	1.75-1.85	0.06-0.2	0.14-0.18	5.6-7.3	High----------	0.32			
424E2*:											
Lindley----------	0-4	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low----------	0.32	5	6	<.5
	4-39	25-35	1.40-1.60	0.2-0.6	0.14-0.18	4.5-6.5	Moderate-----	0.32			
	39-60	18-32	1.45-1.65	0.2-0.6	0.12-0.16	6.1-7.8	Moderate-----	0.32			
Keswick----------	0-6	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6	<.5
	6-28	35-48	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High----------	0.37			
	28-60	30-40	1.60-1.80	0.2-0.6	0.12-0.16	4.5-6.0	Moderate-----	0.37			
425C, 425D, 425D2----------	0-10	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6	<2
Keswick	10-32	35-48	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High----------	0.37			
	32-60	30-40	1.60-1.80	0.2-0.6	0.12-0.16	4.5-6.0	Moderate-----	0.37			
428B----------	0-25	25-30	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7	5-6
Ely	25-47	28-35	1.30-1.40	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.43			
	47-60	20-30	1.40-1.45	0.6-2.0	0.18-0.20	6.6-8.4	Moderate-----	0.43			
452C----------	0-11	22-27	1.45-1.50	0.6-2.0	0.16-0.20	5.1-7.3	Moderate-----	0.37	3	6	1-2
Lineville	11-14	28-35	1.50-1.55	0.2-0.6	0.17-0.21	5.1-6.0	Moderate-----	0.37			
	14-35	20-35	1.65-1.75	0.06-0.2	0.17-0.21	5.6-6.0	Moderate-----	0.37			
	35-60	28-45	1.75-1.85	0.06-0.2	0.13-0.21	5.6-7.3	High----------	0.37			
478G*:											
Gosport----------	0-9	18-27	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.5	Low----------	0.43	3	6	.5-2
	9-30	40-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	High----------	0.32			
	30-60	40-75	1.70-1.90	<0.06	0.08-0.10	4.0-5.0	High----------	----			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
478G*: Rock outcrop.											
484 Lawson	0-35	10-20	1.20-1.55	0.6-2.0	0.22-0.24	6.1-7.8	Low	0.32	5	5	3-5
	35-60	18-30	1.55-1.65	0.6-2.0	0.18-0.20	6.1-7.8	Moderate	0.43			
594C2, 594D2 Galland	0-5	22-35	1.45-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.37	3	6	.5-1
	5-43	35-48	1.45-1.75	0.06-0.2	0.14-0.19	5.1-6.0	High	0.37			
	43-60	10-45	1.55-1.75	0.6-6.0	0.11-0.13	5.1-6.5	Low	0.24			
688 Koszta	0-14	18-24	1.30-1.40	0.6-2.0	0.20-0.24	5.1-7.3	Moderate	0.32	5	6	2-3
	14-60	28-35	1.30-1.45	0.6-2.0	0.15-0.19	5.1-7.3	Moderate	0.43			
731C2, 731D2 Pershing	0-6	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate	0.37	3-2	7	.5-2
	6-51	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High	0.37			
	51-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High	0.37			
732C2, 732D2 Weller	0-6	27-36	1.35-1.45	0.2-0.6	0.22-0.24	4.5-7.3	High	0.43	2	7	.5-1
	6-26	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High	0.43			
	26-60	28-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High	0.43			
792C2, 792D2 Armstrong	0-5	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.32	3	6	.5-2
	5-25	36-48	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High	0.32			
	25-60	30-36	1.55-1.75	0.2-0.6	0.14-0.16	5.1-6.5	Moderate	0.32			
795D Ashgrove	0-10	22-35	1.45-1.50	0.2-0.6	0.20-0.22	4.5-7.3	Moderate	0.43	3	6	1-2
	10-60	40-60	1.45-1.75	<0.06	0.12-0.14	4.5-8.4	High	0.32			
822D2 Lamoni	0-14	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate	0.32	2	7	1-3
	14-46	38-50	1.55-1.75	<0.2	0.13-0.17	5.1-6.5	High	0.32			
	46-60	32-40	1.75-1.85	0.06-0.2	0.14-0.18	5.6-7.3	High	0.32			
832C2 Weller	0-6	27-36	1.35-1.45	0.2-0.6	0.22-0.24	4.5-7.3	High	0.43	2	7	.5-1
	6-26	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High	0.43			
	26-60	28-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High	0.43			
876B, 876C2 Ladoga	0-11	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low	0.32	5	6	.5-3
	11-54	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate	0.43			
	54-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate	0.43			
993D2*, 993E2*: Gara	0-8	24-27	1.50-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.28	5	6	.5-2
	8-54	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate	0.28			
	54-60	24-38	1.75-1.85	0.2-0.6	0.16-0.18	6.6-8.4	Moderate	0.37			
Armstrong	0-5	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate	0.32	3	6	.5-2
	5-25	36-48	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High	0.32			
	25-60	30-36	1.55-1.75	0.2-0.6	0.14-0.16	5.1-6.5	Moderate	0.32			
1130 Belinda	0-6	16-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	4	6	2-3
	6-18	18-27	1.30-1.35	0.6-2.0	0.20-0.22	4.5-6.0	Low	0.37			
	18-41	42-52	1.30-1.45	<0.06	0.12-0.14	4.5-5.5	High	0.28			
	41-60	28-40	1.40-1.50	0.06-0.6	0.18-0.20	5.1-6.0	High	0.28			
1131C Pershing	0-9	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low	0.37	3-2	6	2-3
	9-13	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate	0.37			
	13-37	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High	0.37			
	37-72	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High	0.37			
1279 Taintor	0-18	25-36	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	Moderate	0.28	5	7	4-6
	18-52	35-44	1.30-1.45	0.2-0.6	0.14-0.18	5.6-6.5	High	0.43			
	52-60	24-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.8	Moderate	0.43			

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
5020*:											
Pits.											
Dumps.											
5021*.											
Orthents											
5030*.											
Pits											
5040*.											
Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
11B*: Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Ely	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
13B*: Olmitz	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
Vesser	C	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
23C, 23C2 Arispe	C	None	---	---	2.0-4.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
24D2, 24E2 Shelby	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
41D Sparta	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
51 Vesser	C	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
54, 54+ Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.
58D2, 58E2 Douds	B	None	---	---	4.0-6.0	Apparent	Nov-Jul	>60	---	Moderate	Moderate	Moderate.
65D, 65E, 65E2, 65G Lindley	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
76B, 76C, 76C2, 76D, 76D2 Ladoga	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
80D, 80D2 Clinton	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
130 Belinda	D	None	---	---	0.5-2.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
131B, 131C Pershing	C	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
132B, 132C---------- Weller	C	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High------	High------	High.
133----------------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High------	High------	Moderate.
133B---------------- Colo	B	None---------	---	---	1.0-3.0	Apparent	Nov-Jul	>60	---	High------	High------	Moderate.
133+---------------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High------	High------	Moderate.
179D2, 179E2, 179F, 179F2------ Gara	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
192D2---------------- Adair	D	None---------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High------	High------	Moderate.
211----------------- Edina	D	None---------	---	---	0.5-2.0	Perched	Nov-Apr	>60	---	Moderate	High------	Moderate.
220----------------- Nodaway	B	Occasional	Very brief to brief.	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	High------	Moderate	Low.
222C, 222C2, 222D2------------ Clarinda	D	None---------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High------	High------	Moderate.
223C2, 223D2------ Rinda	D	None---------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High------	High------	Moderate.
260----------------- Beckwith	D	None---------	---	---	+1-1.0	Perched	Nov-Jul	>60	---	Moderate	High------	Moderate.
263----------------- Okaw	D	Rare---------	---	---	+.5-1.0	Apparent	Nov-Jul	>60	---	High------	High------	High.
273C---------------- Olmitz	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
279----------------- Taintor	C/D	None---------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High------	High------	Moderate.
280----------------- Mahaska	B	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High------	High------	Moderate.
281B, 281C, 281C2- Otley	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
313D, 313D2, 313E, 313E2, 313F------ Gosport	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	High.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
362---------- Haig	C/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
364B---------- Grundy	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
419D2, 419E2------ Vanmeter	C	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
423D2---------- Bucknell	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	Moderate	High-----	Moderate.
424E2*: Lindley----------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Keswick----------	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
425C, 425D, 425D2- Keswick	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
428B---------- Ely	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
452C---------- Lineville	C	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
478G*: Gosport----------	C	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	High.
Rock outcrop.												
484---------- Lawson	C	Occasional	Brief-----	Mar-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
594C2, 594D2------ Galland	D	None--------	---	---	3.0-5.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
688---------- Koszta	B	Rare--------	---	---	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Moderate.
731C2, 731D2------ Pershing	C	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
732C2, 732D2------ Weller	C	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	High.
792C2, 792D2------ Armstrong	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
795D---------- Ashgrove	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
822D2---------- Lamoni	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	Moderate	High-----	Moderate.

See footnote at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
832C2---------- Weller	C	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	High.
876B, 876C2------- Ladoga	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
993D2*, 993E2*: Gara----------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Armstrong--------	D	None--------	---	---	1.0-3.0	Perched	Nov-Jul	>60	---	High-----	High-----	Moderate.
1130---------- Belinda	D	None--------	---	---	0.5-2.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Moderate.
1131C---------- Pershing	C	None--------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
1279---------- Taintor	C/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
5020*: Pits.												
Dumps.												
5021*. Orthents												
5030*. Pits												
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
*Adair	Fine, montmorillonitic, mesic Aquic Argiudolls
Arispe	Fine, montmorillonitic, mesic Aquic Argiudolls
*Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Ashgrove	Fine, montmorillonitic, mesic, sloping Aeric Ochraqualfs
Beckwith	Fine, montmorillonitic, mesic Typic Albaqualfs
Belinda	Fine, montmorillonitic, mesic Mollic Albaqualfs
Bucknell	Fine, montmorillonitic, mesic, sloping Udollic Ochraqualfs
Clarinda	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Clinton	Fine, montmorillonitic, mesic Typic Hapludalfs
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Douds	Fine-loamy, mixed, mesic Typic Hapludalfs
Edina	Fine, montmorillonitic, mesic Typic Argialbolls
Ely	Fine-silty, mixed, mesic Cumulic Hapludolls
Galland	Fine, montmorillonitic, mesic Aquic Hapludalfs
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Gosport	Fine, illitic, mesic Typic Dystrochrepts
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Haig	Fine, montmorillonitic, mesic Typic Argiaquolls
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
Koszta	Fine-silty, mixed, mesic Udollic Ochraqualfs
Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
*Lamoni	Fine, montmorillonitic, mesic Aquic Argiudolls
Lawson	Fine-silty, mixed, mesic Cumulic Hapludolls
Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Lineville	Fine-loamy, mixed, mesic Aquollic Hapludalfs
Mahaska	Fine, montmorillonitic, mesic Aquic Argiudolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Okaw	Fine, montmorillonitic, mesic Typic Albaqualfs
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Orthents	Mixed, mesic Udorthents
Otley	Fine, montmorillonitic, mesic Typic Argiudolls
Pershing	Fine, montmorillonitic, mesic Aquollic Hapludalfs
*Rinda	Fine, montmorillonitic, mesic, sloping Mollic Ochraqualfs
*Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Taintor	Fine, montmorillonitic, mesic Typic Argiaquolls
Vanmeter	Fine, illitic, mesic Typic Eutrochrepts
Vesser	Fine-silty, mixed, mesic Argiaquic Argialbolls
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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