Soil survey of Florence County, Wisconsin. Bulletin No. 84, Soil Series No. 59 1962

Hole, Francis Doan, 1913- et al.
Madison, Wis.: The State, 1962

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SOIL SURVEY

OF

FLORENCE COUNTY WISCONSIN

THE UNIVERSITY OF WISCONSN

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

G. F. HANSON,
Director and State Geologist

F. D. Hole, *in charge*
Soil Survey Division

IN COOPERATION WITH

THE SOILS DEPARTMENT, COLLEGE OF AGRICULTURE

AND

THE SOIL CONSERVATION SERVICE, U.S.D.A.

Bulletin No. 84 **Soil Series No. 59**

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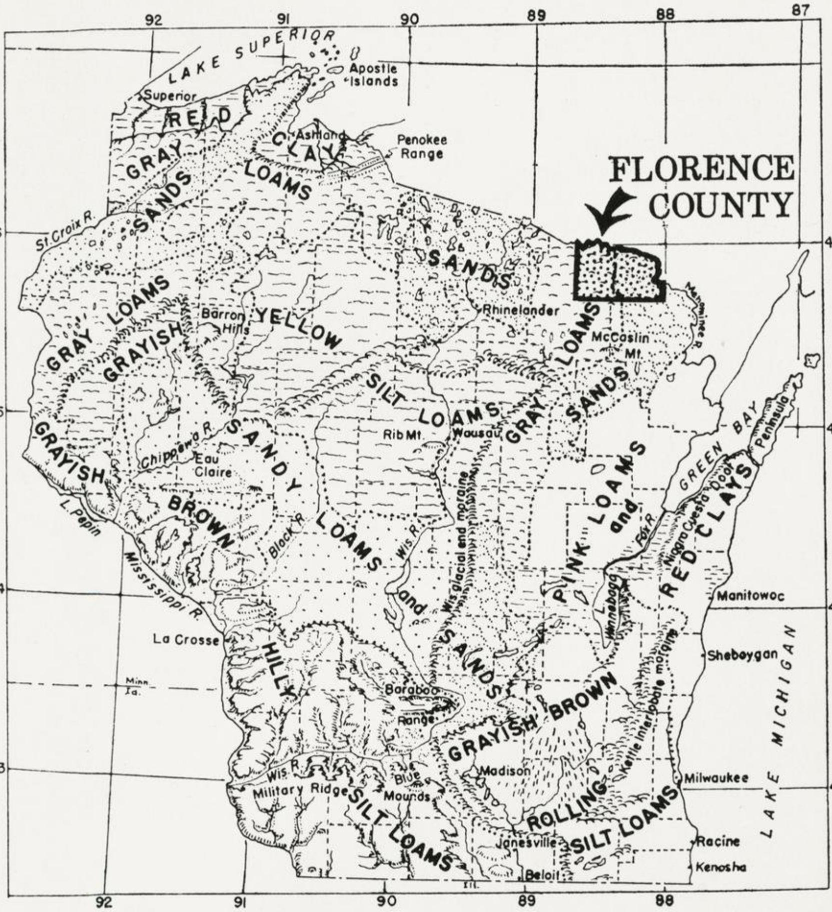

Figure 1. This generalized soil map of the state shows a dotted soil boundary between "gray loams" on the west and "sands" on the east, entering Florence County from the south. But, as the colored soil map accompanying this report shows, there are many kinds of "sands" and "gray loams" in Florence County. Each kind of soil in the county has a characteristic profile (cross-section), showing definite horizons (soil layers), and a characteristic landscape. This is illustrated by the two examples on page 2, representing two very different soils of the county.

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FLORENCE COUNTY WISCONSIN

by

Francis D. Hole, Gerald W. Olson, Keith O. Schmude, and Clarence J. Milfred

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In cooperation with

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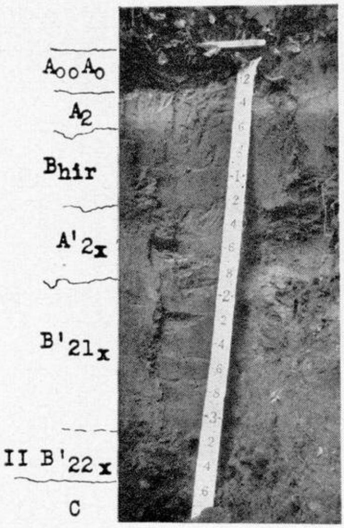

Figure 2. This is a Stambaugh silt loam (see page 88), a productive soil found on outwash flats. The soil profile (pit face on the left) has a stony till-like layer at the bottom, between the 3.2 feet of silty material above and the sand and gravel below the floor of the pit (not visible in the picture). The organic mat (A_{oo} and A_o) of the forest floor is underlain by a pale silt loam (A_2) and then a coffee-brown silt loam (B_{hir}). Below that is a second pale layer which is slightly cemented (A'_{2x}) and a thick, brown somewhat clay-enriched compact layer (B'_{2x}), the lower part of which (II B'_{22x}) is developed in stony material. The landscape picture is a view of the flat south of Patten Lake, as seen from a road cut through Goodman silt loam on glacial till (unit number 1 on the colored soil map). Stambaugh soils are farmed on the flat in the middle distance, and are forested in the sections beyond (unit number 6 on the colored soil map).

Figure 3. This is the Au Train loamy sand, an extremely well developed Podzol. The foot ruler in the left-hand picture gives scale of the soil profile. Tree roots are evident in the lower part of the A_2 horizon, just over the cemented B_{hir} or "Ortstein" horizon. Below the Ortstein is slightly paler, coherent, banded or stratified material, the A'_2 with tendencies toward a fragipan, and below that, the C (not shown). The view is from a field, which has been cultivated for more than sixty years, to a mixed deciduous-coniferous forest. Gaikawad and Hole (1961) have studied this soil at both sites, in the forest and field. This is a small, nearly level soil body in unit number 12 on the soil map.

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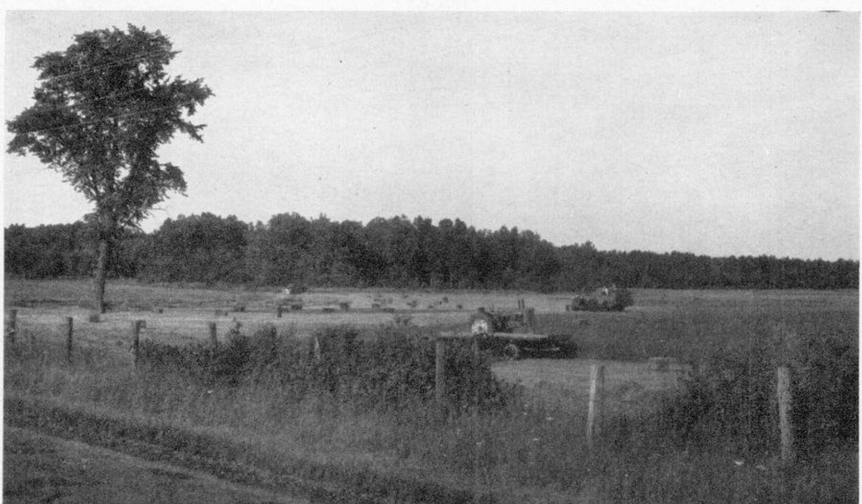

Figure 4. Hay harvest in progress on Hibbing silty clay loam, associated with Zim silt loam in the N.W.¼ of section 2, T.38N., R.18E. This is unit number 5 on the colored soil map.

SOIL PHOTO-MAP

Parts of Sections 15, 16, and 17, Town of Florence, Florence County, Wisconsin Adapted by permission from a field sheet of the Soil Conservation Service, prepared by Harvey V. Strelow, Soil Scientist. The aerial photograph shows an area about one mile and a half wide, west to east, and one and a tenth mile wide, south to north. The largest lake is Mud Lake, and a portion of the Brule River is shown in the northeast corner of the picture.

Figure 5

LEGEND

Sample symbol: 110–2–1
Soil—Slope—Erosion
Pence loam—2% slope—slightly eroded

Soil Number

- 4 Linwood muck and other peat and muck soils
- 21 Iron River loam
- 68 Cable stony loam
- 103 Worchester loam[1]
- 104 Padus loam
- 110 Pence loam
- 111 Pence sandy loam

Slope

Numbers and Letters.
A = 0 to 2% slope gradient
2, 3, 4 ,5, 6, etc. = slope gradient in per cent (feet of fall per 100 ft. of horizontal distance)
K = Irregular (complex) slopes, 6–15%.
Erosion symbols on the map
1 = Slight erosion
2 = Moderate erosion
3 = Severe erosion

Other Symbols

White square = farm building
Diamond = natural pit or "kettle"
Check mark = bedrock outcrop
W = Water (lake, pond)
T. E. = terrace escarpment (steep slope leading down to a depression)
Cross = registration point to orient soil map onto photographic base
Dash-dot lines with arrows = drainage channels.

[1] This imperfectly drained associate of Pence and Padus soils is not mentioned elsewhere in this report.

REPORT ON THE RECONNAISSANCE SOIL SURVEY OF FLORENCE COUNTY, WISCONSIN

By Francis D. Hole, Gerald W. Olson, Keith O. Schmude, and Clarence J. Milfred

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Soil is a basic natural resource of Florence County. This reconnaissance soil survey report and map constitute an inventory of this important resource. The map shows where the different kinds of soils occur in relation to waterways, roads, and civil boundaries. The report describes the soils and landscapes.

I. INTRODUCTION TO THE SOIL MAP AND REPORT

How to use the generalized colored soil map accompanying this report. The soil map shows soil associations, sometimes called soil communities (p. 96), each of which consists of several soils. For example, soil unit number "1" on the map is "Goodman and associated soils, nearly level to undu-

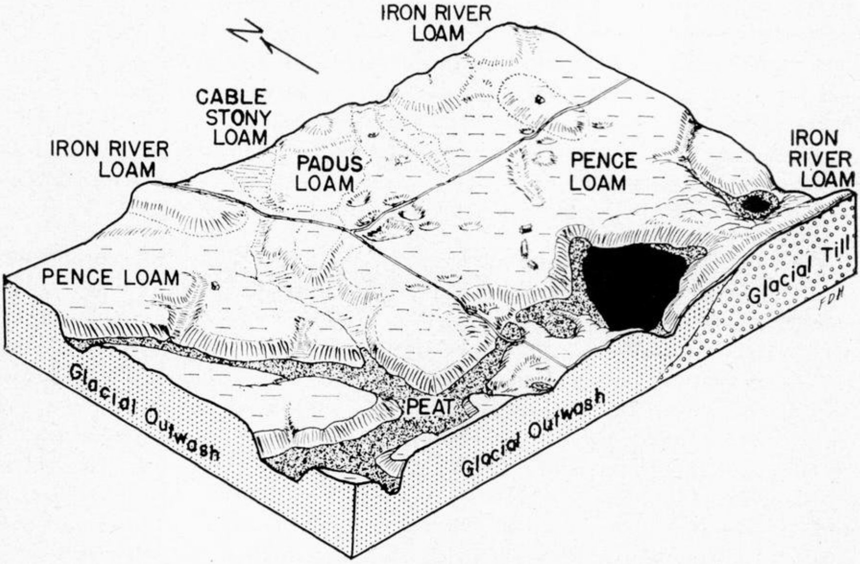

Figure 6. Block diagram of the same area is shown in the map of Figure 5. The view is from the southwestern corner of the map.

lating," and consists of five soils (see Table XIV): Goodman, Auburndale, Stambaugh, and Gaastra silt loams and Iron River loam and silt loam. These soils occur side by side in a level to undulating field or forested landscape. The soil key in Figures 28 and 35 can be used along with the map to good advantage in the field. By means of the soil map the user may locate himself on a body numbered "1." With a spade he can clear off a road bank or can dig in a field or woods to a depth of about 3 feet to expose soil layers or horizons (see Figure 16). By reading from left to right on a soil key, using his observations of the soil layers as a guide, he can find the proper name of the soil. The soil map tells what soils occur together at a given place, and the soil key tells how to distinguish these several soils, one from another. Detailed soil descriptions and various interpretive soil ratings are given in this report.

How the soil map was made. The map has a scale of one inch equals one mile, and was compiled from field observations made in the summers of 1958, 1959, 1960, and 1961, from the 1915 reconnaissance soil map of Northeastern Wisconsin (Whitson, A. R. and Geib, W. J.[1]), from several scattered farm soil maps by Mr. Harvey V. Strelow of the Soil Conservation Service, and from data on relief taken by steroscopic examination of aerial photographs of Florence County. U. S. Geological Survey planimetric quadrangle maps and aerial photos were used in field mapping. K. O. Schmude and G. W. Olson served in turn as party chiefs; James F. Krueger and Clarence J. Milfred assisted as soil surveyors; and F. D. Hole acted as soil correlator in the field. Shankar T. Gaikawad conducted a field and laboratory study of the Au Train soil in 1960 and 1961. Field reviews in September, 1959, and August, 1961, were conducted by A. H. Paschall and Lacy Harmon, Soil Correlators, working with A. J. Klingelhoets, Paul Carroll, and H. V. Strelow, all of the Soil Conservation Service, and the authors. The final map was compiled from field sheets by R. D. Sale, Cartographer of the Wisconsin Geological and Natural History Survey, assisted by Rodney Helgeland, Peter J. Claeys, and the authors. The base map was constructed by Prof. R. D. Sale and his students in cartography.

Where to find detailed soil maps. This publication does not contain detailed soil maps of Florence County, but a sample is shown in Figure 5. A number of detailed farm soil maps, like the sample on page 6, have been made at the request of farmers and can be consulted in the office of the Soil Conservation Service. The soil map in Figure 5 shows individual soil bodies and labels them by means of symbols which are explained in the legend below the map. Each soil body on the map is designated as a kind of soil having a specific slope and erosion condition. Figure 6 is a sketch of the same area, showing several soil associations or soil communities. North and west of the lake, shown in the sketch (Figure 6), is a pitted and dissected plain on which Pence loam is the predominant soil. It formed in

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[1] Items in parentheses refer to items in the bibliography.

glacial outwash sands and gravels. Cable stony loam is a wet depressional soil found at the north edge of the map. Hills of stony till on which Iron River loam soils have formed, protrude above the outwash deposits. There are a number of pits in the Pence-Padus soil plain, particularly close to the road intersection near the center of the area. These pits were made by the melting of glacial ice blocks buried in the sand and gravel centuries ago (Thwaites, 1926). Peat occupies low-lying areas leading to Mud Lake and to the small body of water just east of the lake. There are bedrock outcrops on the sides of the hill near the northwest corner of the area.

Contents of this report. Most technical terms in this report are defined in footnotes or in the glossary. For further explanation the reader may refer to *Soils and Men* (1938), and *Soil* (1957). This report includes detailed descriptions of the recognized soils of the county (Chapter VI), a classification of the soils (Chapter III), and descriptions of the soil associations (or soil "communities") (Chapter VII). Interpretive chapters include a consideration of the factors of soil formation (Chapter V), and soil ratings for various uses (Chapter IV). Detailed laboratory analyses and a bibliography are found in the Chapter VIII. A brief discussion of the history and agriculture and silviculture of the county is given in Chapter II. Remarks on soil management are on pages 16, 17, and 24.

II. FLORENCE COUNTY HISTORY, AGRICULTURE, FORESTRY

The present boundaries of Florence County were established in 1882. The name, assigned by H. D. Fisher to an iron ore deposit (discovered in 1877), to the village near-by, and to the county, was in honor of Florence Hulst,

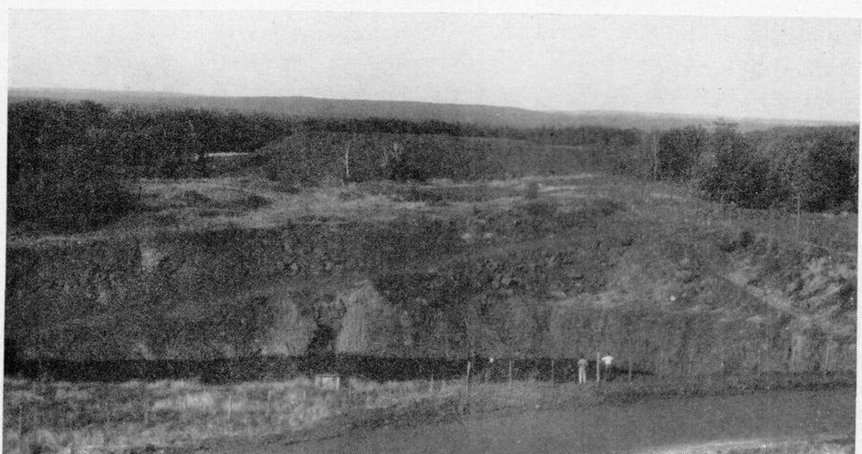


Figure 7. Open pit iron mine southeast of Florence, Wisconsin in the center of Section 34, T.40N., R.18E. The surrounding soils are of the Wakefield and Ahmeek series, unit number 3 on the colored soil map.

wife of a Milwaukee physician. Mining operations began at the Florence mine during the winter of 1879–1880 when 30,000 tons of ore were produced there (Ebling, 1957). Peak of production was in 1920. The mine is in the "Menominee Range," ore from which was first collected by an American Indian, and given to a Mr. Barbeau, who in 1849 reported the find to geologist C. T. Jackson, in charge of mineral surveys on federal lands in Michigan.

In 1880 there were about 300 persons living in Florence County, supported by mining, hunting, fishing, lumbering, and farming. The farmers produced crops and livestock for subsistence and for supplying lumber camps with meat, potatoes, carrots, turnips, and rutabagas. The word "fence," used in the names of a town and of a village in Florence County, probably refers to the early practice among Indians of the territory to capture deer by building fences near lakes and rivers which guided the deer into corrals or directly to the hunters (Habeck and Curtis, 1959). In 1890 the population had increased to 2,604 and there were 90 farms in the county. In 1920, 1935, 1950, and 1959 the population figures were about 3,600, 4,000, 3,700, and 3,437, respectively, and the number of farms stood at 349, 580, 395, and 185, respectively.

Nearly half of the settlers were born in Wisconsin, according to the 1905 Census of Wisconsin; two-thirds were born in the United States; of the foreign born, two-fifths were of Swedish origin, and the others included persons from Germany and Canada. The development of dairy farming meant the return to the soils of plant nutrients and organic matter in the form of manure. The increased use of lime and commercial fertilizers, and the adoption of erosion control practices, have improved both soil conditions and crop production. It still cannot be said, however, that man-induced soil erosion has been brought under control in Florence County.

In 1950, of the labor force of 1,028 workers, 35 per cent were employed in agriculture, as compared with about 20 per cent of the labor force for the state as a whole. In 1954 the average acreage of a farm was 160.6 acres and the total combined area of farms was 50,736 acres, or 16.2 per cent of the land area of the county. Farms were located chiefly in southern and southeastern sections. By 1959 the average size of farm was 185.5 acres, and the total farm area was 34,312 acres, or 11 per cent of the area of the county. As the total number of farms and the total acreage in farms in the county have decreased, the average size of a farm has increased. Only 2.2 per cent of the farms were tenant-operated in 1959. Farmland in Florence County was utilized as follows in the same year: 31.9 per cent in unpastured woodland, 24.6 per cent in cropland harvested, 23.3 per cent in pastured woodland, 6.7 per cent in pastured cropland, 4.7 per cent in other pasture land, 4.6 per cent in roads and houses and wasteland, and 4.2 per cent in unused cropland. The total available cropland amounted to 39.5 per cent of the area of farmland. Principal crops harvested were clover and timothy hay, alfalfa hay, oats, corn for silage, grass silage, and Irish potatoes (U.S.D.C., 1959).

Of the total value per farm ($3,533) of all farm products sold in 1959, 65.6 per cent was from the sale of milk, 14.7 per cent from the sale of livestock and livestock products other than poultry and dairy, 16.8 per cent from the sale of all crops, a fourth of which were forest products and horticultural specialty products, and 2.7 per cent from sale of poultry and poultry products.

Commercial forestland occupied about 87 per cent of the county in 1956, of which 28.4 per cent by area was in the Nicolet National Forest, 1.3 per cent under state control, 17.1 per cent owned by county or municipal units, 40.4 per cent held by private owners other than farmers, and 12.8 per cent owned by farmers. The most abundant species and associations of trees in the forest are, in percentage of forestland area: aspen (41.0 per cent by area of forestland); northern hardwoods (26.8 per cent); upland brush and grass (7.8 per cent); fir-spruce (8.2 per cent); black spruce, lowland brush, jack pine, cedar, hemlock-hardwoods, white and red pine, scrub oak, swamp hardwoods, and tamarack (16.2 per cent) (Wisconsin Conservation Department, 1957). In 1956 approximately 17 per cent of the forest stand was of saw-timber quality, 30 per cent was in the form of pole-timber, and 44 per cent was in young seedling and sapling stands. In 1957, about a third of the forest land was entered under the Forest Crop Law, which provides that most of the taxes of forestland can be deferred until the products are harvested. Only 0.02 per cent of the forest land was entered under the Woodland Tax Law, which was designed for small tracts of woodland. Woodland products included saw-timber, pulpwood, excelsior, fuelwood, fence posts, logs and bolts for miscellaneous uses (match stock, heading stock, clothes pins, cabin logs, shingles, lath), veneer logs, chemical wood, pole-timber, and maple syrup and sugar. The value of forest products sold from Florence County farms in 1954 was $40,700.

The large acreage of forest land, the presence of more than 80 lakes, of which 44 are one-quarter of a mile or more across and about 29 trout streams totaling 205 miles in length, abundance of game (Wisconsin Conservation Department, 1961), cool summers, and much snow and ice in winter account for the importance of the tourist industry in Florence County. "The Popple River is as yet untouched and its scenic resources are unique," (Blankenheim, *et al,* 1961) attracting canoeists and fishermen.

III. A CLASSIFICATION OF SOILS OF FLORENCE COUNTY

Introduction to the Soil Keys

Florence County has a total of 318,080 acres (Martin, 1932) of which the soil map shows 8,270 acres covered by water, leaving 309,810 acres of land.

Seventeen soil units are listed in the legend of the soil map (see Table XIII). A complete list of the 44 recognized soil series and one miscellaneous land unit, with estimated acreages, is given in Table XII.

Two types of soil keys are included in this report: graphic keys, Figures 28 and 35, and a tabular key, Table I. The graphic keys can be taken into

TABLE I. TABULAR KEY TO THE SOILS OF FLORENCE COUNTY, WISCONSIN

Parent Materials			Upland[6] Soils										
						Podzols[7]							
						Well to excessively drained[8]			Imperfectly[12] drained	Poorly drained			
Surface Materials[1]		Substrata	Regosolic[2] and Lithosolic[2] soils	Acid Brown Forest[3], Brown Podzolic[4] and disturbed Podzol soils	Gray Wooded[5] Soils	Minimal[9] development	Medial[10] development	Maximal[11] development	Minimal and medial development	Maximal development: Ground-Water[13] Podzol	Low Humic-Gley[14] soils	Humic-Gley[15] soils	Bog[16] soils
Silty or very fine sandy loam surface layer present	Surface layer is 24″ to 42″ deep	Acid, medium to coarse sand and/or gravel					Stambaugh silt loam						
		Acid loam till (7.5YR-2.5YR)	"Granitic" rock outcrops	Ahmeek silt loam, loam, deep phase			Goodman* silt loam		Gaastra silt loam		Auburndale silt loam	Adolph silt loam	Greenwood and Spalding peats
	Surface layer 18″–66″ deep	Acid, very fine, fine and medium sands					Fence* silt loam, very fine sandy loam. Normal (18″–42″) and deep phases		Tipler* silt loam, very fine sandy loam				
	Surface layer less than 24″ thick	Sandy loam till (7.5YR–10YR)					Iron River sandy loam, loam, silt loam				Cable* silt loam		Linwood muck
	Surface layer less than 18″ thick	Acid loam and clay loam till (2.5YR–5YR)		Ahmeek silt loam, loam			Wakefield* silt loam, loam						
		Clay, silty clay, calcareous (2.5YR–5YR)					Superior silt loam, fine sandy loam						
		Stratified silt, very fine sand, clay lacustrine deposits, calcareous at 30″–100″					Bohemian silt loam, very fine sandy loam, loam		Brimley silt loam, very fine sandy loam, loam			Bruce silt loam	
		Stony sand and gravel; little or no limestone, dolomite or marble	Emmert gravelly sandy loam, gravelly loam, gravelly silt loam										

TABLE I. TABULAR KEY TO THE SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Parent Materials				Upland[6] Soils										
							Podzols[7]							
							Well to excessively drained[8]			Imperfectly[12] drained	Poorly drained			
Surface Materials[1]		Substrata		Regosolic[2] and Lithosolic[2] soils	Acid Brown Forest[3], Brown Podzolic[4] and disturbed Podzol soils	Gray Wooded[5] Soils	Minimal[9] development	Medial[10] development	Maximal[11] development	Minimal and medial development	Maximal development: Ground-Water[13] Podzol	Low Humic-Gley[14] soils	Humic-Gley[15] soils	Bog[16] soils
Silty or very fine sandy loam surface layer present	Surface layer less than 8″ thick	Clay or silty clay, calcareous (2.5 YR-5YR)	Till			Hibbing silt loam, silty clay loam, clay loam				Zim silt loam, silty clay loam, clay		Tromald silty clay, clay loam		
			Lacustrine deposits			Ontonagon clay, silty clay, silt loam				Rudyard silty clay loam		Pickford clay, silty clay loam	Bergland clay, silty clay loam	
Loam or sandy loam surface layer present (upper 10″ may be silt loam)	Layer is 15″–24″ thick	Acid medium to coarse sand and gravel						Pence loam, sandy loam, loam						
	Layer is 24″–42″ thick							Padus* loam, sandy loam, loam						
Sandy loam or loamy sand surface layer present	Layer is 18″–42″ thick	Loam to silty clay loam, calcareous (2.5YR-5YR)						Ubly (variant) sandy loam, loamy fine sand						
	Layer is 18″–30″ thick	Acid loamy fine sand, fine sand, and sand, stratified						Randville loamy fine sand, fine sandy loam		Moye loamy fine sand, fine sandy loam				
Loamy sand or sand surface layer present	Layer is 18″ to 42″ thick	Loam to silty clay loam, calcareous (2.5YR-5YR)						Menominee sand and loamy sand						
		Silty clay to caly, calcareous (2.5YR-5YR)						Manistee sand, loamy sand						
	Layer is 5″ to 36″ thick	Clay, silty clay, calcareous (2.5YR-5YR)						Superior loamy sand, sand, normal (5″–18″) and deep (18″–36″) phases						

TABLE I. TABULAR KEY TO THE SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Parent Materials			Upland[6] Soils										
						Podzols[7]							
						Well to excessively drained[8]			Imperfectly[12] drained	Poorly drained			
Surface Materials[1]		Substrata	Regosolic[2] and Lithosolic[2] soils	Acid Brown Forest[3], Brown Podzolic[4] and disturbed Podzol soils	Gray Wooded[5] Soils	Minimal[9] development	Medial[10] development	Maximal[11] development	Minimal and medial development	Maximal development Ground-Water[13] Podzol	Low Humic-Gley[14] soils	Humic-Gley[15] soils	Bog[16] soils
Very sandy material	15″–30″ of loamy sand to light sandy loam (with some gravel)	Deep acid fine to medium sand with a little gravel		Crivitz* loamy sand, sandy loam		Crivitz* loamy sand, sandy loam							
	0″–10″ of loamy sand present at the surface	Deep acid sand; bands of finer material may be present	Omega sand, loamy sand			Vilas sand, loamy sand	Hiawatha sand, loamy sand	Au Train sand, loamy sand		Saugatuck sand, loamy sand			Greenwood and Spalding peats
		Deep neutral to calcareous sand									Roscommon loamy sand, sand		
						Alluvial Soils							
Materials variable							Excessively drained	Well drained	Moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained	Bog soils
	Reddish-brown to brown acid materials							Brule silt loam, loam, fine sandy loam, and loamy fine sand					
	Materials variable							Alluvial soils, undifferentiated		Alluvial soils undifferentiated			Edwards muck, Linwood muck

*Tentative soil series.

the field by the observer, who stands on a soil body and reads across the upper half of the keys from left to right to find the soil name which best fits the characteristics of the soil as seen in a pit or in soil samples pulled up with a soil auger (Hole and Lee, 1953). Shallow Podzol soils, with *A* horizons less than plow depth in thickness (6″–8″) are classified on the basis of the *B* horizons, which are left essentially undisturbed by plowing (Gaikawad, 1961). The tabular soil key lists the parent materials on the left side. The remaining columns, from left to right, arrange the soils in order from the most droughty to the wettest. In this table, natural soil drainage or aeration relationships are assumed, which means that the soils are classified according to the natural condition, before tiling or ditching or irrigation has been introduced. Because most soils do not change color noticeably, even after drainage or irrigation, the tabular key is useful in classifying soils according to their original characteristics.

It can be seen from the soil keys that Florence County has a variety of soils, including gravelly and sandy, droughty soils; deep, wet peats; patches of two-inch-thick soil over bedrock outcrops; and deep silty soils.

FOOTNOTES FOR TABLE I

[1]Parent materials are inorganic and organic materials from which soils are forming.

[2]Regosolic and lithosolic soils are very young soils over unconsolidated and consolidated geologic materials, respectively. These soils have scarcely any B horizon.

[3]An Acid Brown Forest soil has fairly uniform color throughout, and nearly uniform content of clay from top to bottom of the solum, but exhibits structural differences between the A and B horizons.

[4]A Brown Podzolic soil has an A_1 horizon resting directly on a Podzol B horizon, without intervening A_2 horizon.

[5]A Gray Wooded soil has a humus layer on the forest floor, overlying a pale gray A_2 which tongues down into a blocky prismatic B horizon, scattered units of which are completely enveloped in the lower A_2.

[6]Upland soils are well drained to poorly drained soils lying above bottomlands or alluvial soils. In Florence County, the distinction between outwash terrace and till uplands is not as clear as in some counties of southern Wisconsin, such as Dane County. Therefore, all non-alluvial soils are grouped as Upland soils in this table.

[7]A Podzol soil has a thick humus layer on the forest floor overlying a pale pinkish gray A_2 horizon over a dark brown B horizon in which iron and/or organic matter have been deposited.

[8]Well drained soils are medium textured soils (silt loams, loams, and fine sandy loams) which show little or no mottling in the A, B and upper C horizons. Excessively drained soils show no mottling in the profile, and include deep gravels and sands, and medium textured soils overlying sand and gravel.

[9]A minimal Podzol is a weakly developed Podzol. In Florence County this Podzol in sand has an A_2 ½ to 3 inches thick, and an orterde (5YR 3/4 to 2.5YR 2/4) 5 to 7 inches thick. In silty material, this Podzol shows an A_2 about one inch thick and a B horizon (5YR 3/4) 3 to 5 inches thick, with medium platy to weak subangular blocky structure. Reference is to colors of moist soil.

[10]A medial Podzol is moderately well developed one. In Florence County, this Podzol shows an A_2 horizon 3 to 7 inches thick and a stronly developed orterde 7 to 14 inches thick in sandy material. In silty material, this Podzol has an A_2 horizon 2 to 6 inches thick and a B horizon (5YR 3/4) 8 to 15 inches thick, with medium platy to weak subangular blocky structure.

[11]A maximal Podzol is well developed. In Florence County this Podzol is found in sandy material and has an A_2 horizon 7·to 15 inches thick and a cemented ortstein "hardpan" 6 to 20 inches thick.

[12]Imperfectly drained soils are those which under natural drainage conditions show distinct mottling in the B, C, and lower A horizons.

[13]Ground-Water Podzols are poorly drained Podzols showing maximal development and found associated with peat. These soils are believed to have formed under wet conditions, with fluctuating water table an important factor.

[14]Low Humic-Gley soils have dark A horizons which are shallower than plow-depth (about 7 inches), overlying gray subsoil.

[15]Humic-Gley soils have black A horizons which are deeper than plow-depth, overlying gray subsoil.

[16]Bog soils are organic soils (peat and mucks) formed primarily from organic materials such as moss, grass, reeds, trees, and other bog vegetation.

*Tentative Soil Series.

IV. SOIL RATINGS FOR VARIOUS USES IN FLORENCE COUNTY, AND GENERAL MANAGEMENT RECOMMENDATIONS

Introductions to the Soil Rating Tables

There are three tables of soil ratings: Table II, with ratings for several general land uses; Table III, with ratings for soil productivity for hardwood and conifer trees; and Table IV, with ratings for agricultural row crops. For detailed, current soil management recommendations, consult the County Agricultural Agent, and specialists of the Agricultural College and the Soil Conservation Service. Tables V and VI present some data and recommendations of interest to highway engineers.

Soil Ratings for General Uses

The first of the three tables is designed to help plan the use of a particular body of soil, or for considering treatment of a soil body once its use has been decided upon. Wise planning of land use takes into account the capabilities of the soils in order to avoid trying to grow corn on soils unsuited to corn, or trying to establish homes on low-lying sites which are flooded seasonally, or developing parks and other recreational areas on soils which are not associated with bodies of water or on which artificial bodies of water cannot be created.

In Table II, the soil ratings for forestry (hardwoods and conifers) are generalized from Table III. The soil ratings for pasture and cultivated crops are generalized from Table IV. Suitability ratings of soils for industrial sites assume that pervious, well-drained, undulating soils provide the best conditions. Two sets of ratings for home sites are for homes with private sewers and for homes with public sewers. It is assumed that no homes should be located on wet sites, where soil drainage ranges from imperfect to very poor. Home sites with private sewers require adequate areas of permeable soils capable of absorbing effluent properly. Soil ratings for transportation routes give priority to deep, well-drained, pervious, stone-free soils of level to gently rolling topography. In rating soils for camp sites, level, well-drained soils were considered best. Other features such as vegetative cover and proximity to lakes or rivers were not considered in the soil ratings for camp sites. Highest ratings for hiking terrain were given to rolling to hilly, well-drained soils.

Ratings of soils for wildlife require special explanation. Most species of wildlife live on a wide range of soils, from peat bogs to dry sands on esker-like ridges. The beaver is an exception in confining its activities to a narrow range of soils, namely those occurring beside streams and lakes (see Figure 11). The factors[1] limiting population of animals in Florence County include: (1) ecological stage of the vegetation, (2) natural fertility of the

[1] Personal communications from W. Wertz, U. S. Forest Service; Cyril Kabat and James B. Hale of the Wisconsin Conservation Department.

soils, and (3) frequency of occurrence of ecologic tension zones between wet soils and well-drained soils. Diversity of vegetative cover is, in general, favorable to wildlife. This diversity is characteristic of infertile sands, like Vilas loamy sand, and especially of boundaries between contrasting soils. The borders of the small peat bogs, for example, which occupy many of the pits or "kettles" in Florence County (see Figure 25) provide a wide variety in vegetative cover. Many logging trails in Florence County run along soil boundaries, because natural topographic breaks are in many instances coincident with changes in soil. The trails help create conditions favorable to diverse vegetative cover. Soil associations of diverse kinds of soil occurring in small bodies provide many more miles of transition belts per section than do associations of extensive bodies of similar soils. An attempt is made to express some of these relationships by assigning a potential productivity rating to each soil and soil association in Table II for white-tail deer and ruffed grouse. Soils which are most productive of vegetation may not carry vegetative cover favorable to wildlife unless special management practices are used, such as maintenance of artificial openings and food patch seeding. If proper wildlife management practices are used, then soils like Goodman silt loam, which are relatively high in natural fertility, can become productive of wildlife. Opening up of the forest in the course of block timber cutting allows these naturally fertile soils to produce the major population of wildlife in the county.

Soil Ratings for Forestry Uses

Lumber, pulp wood, Christmas trees, fence posts, and fire wood can be taken from forests according to approved methods. Trees protect soil from erosion. Care must be taken to avoid soil erosion along access roads into woodlands.

S. A. Wilde and others (Wilde, 1958; Wilde, Wilson, and White, 1949) have outlined the principles of woodland soil management. A. J. Klingelhoets and M. T. Beatty have published a summary statement recently (1961), and have listed soil productivity ratings for hardwood and conifer trees. These form the basis for Table III, which gives average ratings by soil type for all slopes, from level to hilly. For high level of woodland management the operator should: (1) establish trees best adapted to the soil, (2) fertilize the soil according to tests and recommendations by soils and forestry specialists, (3) maintain the optimum number of trees per acre, (4) harvest and make improvement cuts to favor the more desirable species, (5) protect from livestock grazing and from fire, and (6) apply control practices where serious disease and insect infestations occur. Forest management involves constant attention to imbalances. For example, some 55 square miles of northern hardwood forest in Fern and Florence and Fence Townships suffered in 1955–1958 maple blight or "die-back," a diseased condition of maple trees apparently connected with web-worm and leaf roller insect damage, which killed or weakened thousands of trees. Appropriate measures for diagnosis and control were taken.

TABLE IIA. GENERAL RATINGS OF SOIL SERIES OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES

Map Symbol[1]	Name of soil type	Ratings[2] for: Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]			Home Sites[5]		Transportation routes[6]	Recreation[7]	
							Deer							
		Hardwoods	Conifers				Summer	Winter	Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
(15, 16)	Adolph silt loam	P	P	U(E)	U(M)	U#	G	G	G	U#	U#	P#	U#	P#
3	Ahmeek silt loam	E	E	G(E)	G(E)	M*	M[x]	P[x]	P[x]	U*	P*	M*	G*	G
(15, 16)	Alluvial soils undifferentiated	P	P	U(M)	U(P)	U#	G	G	G	U#	U#	P#	M#	P#
(1)	Auburndale silt loam	P	M	G(E)	G(E)	U#	G	G	G	U#	U#	P#	U#	P#
(12)	Au Train loamy sand	P	M	U(P)	P(M)	G	G	P	G	P+	G+	G+	G	G
(15)	Berland silty clay loam	P	P	M(G)	M(G)	U#	G	G	G	U#	U#	P#[c]	U#[c]	P#
(14)	Bohemian fine sandy loam	E	E	G(E)	G(E)	G	M[x]	P[x]	M[x]	G	E	G	E	G
(14, 15)	Brimley fine sandy loam	G	E	M(E)	G(E)	P#	G[x]	G[x]	G[x]	U#	P#	P#	P#	P#
(15)	Bruce silt loam	P	P	M(E)	M(E)	U#	G	G	G	U#	U#	P#[s]	U#	P#
(15, 16)	Brule silt loam	G	M	P(M)	M(G)	U[a]	G	G	G	U[a]	U[a]	P[a]	M[a]	M
(15, 16)	Cable loam	P	M	U(G)	U(G)	U#	G	G	G	U#	U#	P#	U#	P#
(5, 9, 10, 11, 12)	Crivitz loamy sand	P	M	U(P)	P(M)	E	G	M	G	E	E	E	E	E
(15)	Edwards muck	P	P	U(—)	U(P)	U#	G	G	G	U#	U#	U#	U#	P#

TABLE IIA. GENERAL RATINGS OF SOIL SERIES OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES—Continued

Map Symbol[1]	Name of soil type	Ratings[2] for: Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]			Home Sites[5]		Transportation routes[6]	Recreation[7]	
		Hardwoods	Conifers				Deer: Summer	Deer: Winter	Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
13	Emmert gravelly sandy loam	P	E	P(—)	U(P)	M[b]	G	G	G	M[b]	M[b]	G	E	E
14 (6)	Fence silt loam	E	E	G(E)	G(E)	G	M[x]	P[x]	M[x]	G	E	G[s]	G	G
(1)	Gaastra silt loam	M	G	M(E)	M(E)	U#	G	G	G	U#	U#	P#[s]	U#	P#
1, 2, (4, 5)	Goodman silt loam	E	E	M(E)	G(E)	E	M[x]	P[x]	M[x]	M	E	M[s]	E	E
17	"Granitic" rock outcrops	U	U	U(—)	U(—)	U*	M	P	P	U*	U*	P*	P*	G
(16)	Greenwood peat	P	P	U(—)	U(—)	U#	G	G	G	U#	U#	U#	U#	P#
(4, 5, 11, 12)	Hiawatha loamy sand	P	M	U(P)	P(M)	E	G	M	G	E	E	E	E	E
5 (4)	Hibbing silt loam	G	G	G(E)	G(E)	M[c]	M[x]	P[x]	M[x]	P[c]	G[c]	M[c]	G[c]	G
4 (1, 2, 3, 6, 9, 13, 17)	Iron River loam	G	E	M(G)	M(G)	E	M[x]	P[x]	M[x]	E	E	E	E	E
(15)	Linwood muck	P	P	U(—)	U(—)	U#	G	G	G	U#	U#	U#	U#	P#
(5)	Manistee loamy sand	P	G	P(M)	P(M)	G	G	M	G	P[c]	E	M[c]	G	G
(5)	Menominee loamy sand	P	G	P(M)	P(M)	G	G	M	G	P[c]	E	M[c]	G	G
(12, 16)	Moye sandy loam	P	P	P(M)	U(M)	P#	G	G	G	U#	U#	P#	U#	P#

TABLE IIA. GENERAL RATINGS OF SOIL SERIES OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES—Continued

Map Symbol[1]	Name of soil type	Ratings[2] for												
		Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]			Home Sites[5]		Transportation routes[6]	Recreation[7]	
							Deer		Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
		Hardwoods	Conifers				Summer	Winter						
(10)	Omega loamy sand	P	M	U(P)	U(P)	E	G	M	G	E	E	E	E	G
(5, 17)	Ontonagon silt loam	M	M	G(E)	M(G)	M^{c}	M^{x}	P^{x}	M^{x}	P^{c}	G^{c}	M^{c}	G^{c}	G
(2, 3, 4, 6, 7, 8, 9, 10, 13)	Padus loam	M	E	M(G)	M(G)	E	M^{x}	P^{x}	M^{x}	E	E	E	E	E
4, 8, 9, 10, 12 (2, 3, 6, 7, 13, 17)	Pence sandy loam	P	E	M(G)	M(G)	E	M^{x}	M^{x}	M^{x}	E	E	E	E	E
(15)	Pickford silty clay	P	M	G(E)	G(E)	U#	G	G	G	$U\#^{c}$	$U\#^{c}$	$P\#^{c}$	$U\#^{c}$	P#
(4, 12, 14)	Randville loamy sand	G	E	U(P)	P(M)	E	G	M	G	E	E	E	E	E
(15)	Roscommon loamy sand	P	P	P(M)	U(M)	U#	G	G	G	U#	U#	P#	U#	P#
(5)	Rudyard silty clay loam	M	M	U(M)	M(G)	P#	G	G	G	$U\#^{c}$	$P\#^{c}$	$P\#^{c}$	P^{c}	P
(15)	Saugatuck sand	P	P	U(P)	U(P)	U#	G	G	G	U#	U#	P#	U#	P#
(15, 17)	Spalding peat	P	P	U(—)	U(—)	U#	G	G	G	U#	U#	U#	U#	P#
6, 7, 8, 9, (1, 2, 13, 14, 17)	Stambaugh silt loam	E	E	M(E)	G(E)	E	M^{x}	P^{x}	M^{x}	E	E	G^{s}	E	E
(5)	Superior sandy loam	M	G	M(G)	M(G)	G	M^{x}	P^{x}	M^{x}	P^{c}	G^{c}	M	G	G
(14)	Tilper silt loam	M	G	G(E)	M(E)	U#	G	G	G	U#	U#	$P\#^{s}$	U#	P#

TABLE IIA. GENERAL RATINGS OF SOIL SERIES OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES—Continued

Map Symbol[1]	Name of soil type	Ratings[2] for: Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]: Deer			Home Sites[5]		Transportation routes[6]	Recreation[7]	
		Hardwoods	Conifers				Summer	Winter	Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
(15)	Tromald silty clay	P	M	G(E)	G(E)	U#	G	G	G	U#	U#	P#[c]	U#[c]	P#
5 (10)	Ubly silt loam	M	G	P(M)	P(G)	G	M[x]	P[x]	M[x]	M	E	M[c]	E	G
10, 11, 12, 13 (4, 5, 6, 9, 17)	Vilas loamy sand	P	M	U(P)	U(P)	E	G	M	G	E	E	E	E	G
3, (2, 4, 5)	Wakefield loam	E	G	M(G)	G(E)	G	M[x]	P[x]	M[x]	P[c]	E	M[c]	E	E
(5)	Zim silty clay loam	M	M	M(G)	M(G)	P[c]	G	G	G	U#[c]	P#[c]	P[c]	P#[c]	P

Notes:

[1]Each map symbol number stands for a soil association listed in the legend of the soil map of Florence County, Wisconsin. In the first column on the left, a number without parentheses represents a soil association which specifically cites the soil names in the second column of the table. A number within parentheses represents a soil association which does not cite the soil in question, but which actually includes small areas of it.

[2]Soil ratings for the various uses indicated are given in the form of letters, which have the following meanings: E—excellent; G—good; M—medium; P—poor; U—unsuitable.

[3]The first rating in each case is for the soils as they are usually managed. The rating in parentheses is for the soils under a high level of management, which may include drainage, erosion control, fertilization. Irrigation could increase productivity ever more than is indicated here. For further information, see table IV.

[4]These ratings of potential productivity of soils for white-tailed deer and ruffed grouse are based on an adaptation of an approach to soil ratings for wildlife developed by W. Wertz, Soil Scientist, U. S. Forest Service, Milwaukee, Wisconsin. Ratings are given for both summer and winter range for white-tailed deer. A single rating is given for the entire year for ruffed grouse. Diversity of vegetative cover (required plant species are present in adequate density or volume), which is an important factor favorable to deer and grouse, is a condition characteristic of borders between contrasting soils and also of infertile sands. Note that ratings for soils which are most productive of vegetation are tagged with a special symbol which is explained in another foot-note. See page 000 for a brief discussion of the relation between soils and wildlife.

[5]"With private sewer" means that a septic tank system is used, requiring drainage of effluent into soil. "With public sewer" means that no drainage of effluent into soil is required.

[6]See Table V for more information on engineering aspects of soils.

[7]Soil ratings for camp sites are based on the assumption that level, well-drained soils are best. Soil ratings for hiking terrain are based on the assumption that rolling to hilly soils are best. In neither case is the proximity of a lake or river taken into consideration in making the soil ratings.

#Wet conditions in this soil unit are unfavorable for the use in question.

*Stoniness or shallowness to bedrock are unfavorable conditions which limit the use indicated with respect to this soil unit.

+A hardpan is present which presents difficulties with respect to the use in question.

[a]Smallness of soil bodies, susceptibility to flooding by rivers, and intimate association with wet soils limit the use of this soil unit.

[b]Hilly topography is an unfavorable condition in this instance.

[c]High content of clay in this soil unit limits its use in this instance.

[s]High content of silt in this soil unit limits its use in this instance.

[x]The soil unit is above average in productivity for vegetation, and therefore if the vegetative cover is managed for the benefit of wildlife (as by the creation of artificial openings in the forest), the rating of the soil for potential productivity of wildlife can be substantially raised above the level indicated in this table.

TABLE IIB. GENERAL RATINGS OF SOIL ASSOCIATIONS OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES

Map Symbol[1]	Name of soil association	Ratings[2] for: Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]: Deer			Home Sites[5]		Transportation routes[6]	Recreation[7]	
		Hardwoods	Conifers				Summer	Winter	Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
1	Goodman and associated soils, nearly level to undulating	E	E	M(E)	G(E)	E	M[x]	P[x]	M[x]	M	E	G[s]	E	G
2	Goodman and associated soils, rolling to hilly	E	E	M(E)	M(G)	E	M[x]	P[x]	M[x]	M	E	M[s]	G	E
3	Wakefield, Ahmeek and associated soils, nearly level to hilly	E	G	M(G)	G(E)	M*	M[x]	P[x]	M[x]	P*	M*	M*[c]	G*	E
4	Iron River, Pence and associated soils, nearly level to hilly	G	E	M(G)	M(G)	E	M[x]	P[x]	M[x]	E	E	G	E	E
5	Hibbing, U bly and associated soils, nearly level to hilly	G	G	M(G)	G(E)	M[c]	M[x]	P[x]	M[x]	P[c]	G[c]	M[c]	G[c]	G
6	Stambaugh and associated soils, nearly level to undulating	G	E	M(E)	G(E)	E	M[x]	P[x]	M[x]	E	E	G[s]	E	G
7	Stambuagh and associated soils, rolling to hilly	G	E	M(E)	M(G)	G[b]	M[x]	P[x]	M[x]	G[b]	G[b]	M[s]	G	E
8	Pence, Stambaugh and associated soils, nearly level to undulating	M	E	M(G)	G(E)	E	M[x]	M[x]	M[x]	E	E	E	E	E
9	Pence, Stambaugh and associated soils, rolling to hilly	M	E	M(G)	M(G)	G[b]	G[x]	M[x]	G[x]	G[b]	G[b]	G	E	E
10	Vilas, Pence and associated soils, nearly level to undulating	P	G	P(M)	P(M)	E	G	M	G	E	E	E	E	G

TABLE IIB. GENERAL RATINGS OF SOIL ASSOCIATIONS OF FLORENCE COUNTY, WISCONSIN FOR VARIOUS USES—Continued

Map Symbol[1]	Name of soil association	Ratings[2] for												
		Forestry		Pasture[3] (Legume-grass)	Agricultural cultivated crops[3]	Industrial Sites	Potential for Wildlife[4]			Home Sites[5]		Transportation routes[6]	Recreation[7]	
							Deer		Grouse	With private sewer	With public sewer		Camp Sites	Hiking Terrain
		Hardwoods	Conifers				Summer	Winter						
11	Vilas and associated soils, rolling to hilly	P	M	U(M)	U(P)	G^{b}	G	G	G	G^{b}	G^{b}	G	E	G
12	Vilas, Pence and associated soils, rolling to hilly	P	G	P(M)	U(P)	E	G	M	G	G^{b}	G^{b}	G	E	E
13	Emmert, Vilas and associated soils, rolling to hilly	P	G	U(P)	U(P)	M^{b}	E	G	E	G^{b}	G^{b}	G	E	E
14	Fence and associated soils, nearly level to undulating	E	E	G(E)	G(E)	G	M^{x}	P^{x}	M^{x}	G	E	G^{s}	G	G
15	Peat, muck, and associated soils, nearly level to gently sloping with forest cover	P	P	U(P)	U(P)	U#	E	E	E	U#	U#	P#	U#	P#
16	Peat, muck, and associated soils, nearly level to gently sloping, without forest cover	P	P	U(P)	U(P)	U#	E	E	E	U#	U#	P#	U#	P#
17	"Granitic" Rockland, and associated soils	P	M	P(M)	P(M)	P*	M	P	P	P*	M*	P*	G	E

Note: Please refer to footnotes of Table IIA.

Soil Ratings for Agricultural Uses

Crop yields vary from soil to soil. The soils which support best crop yields may be regarded as "blue-ribbon" soils, which like animals of proven high productivity, are indispensable economic assets in the agricultural economy. Like a superior animal, a superior soil has a fine heritage and has received good care from its owner. An "unproductive" soil, like Emmert gravelly sandy loam, cannot be eliminated from the farm, as a poor stock animal can, except as the "poor" soil is excavated and hauled off the farm in sand and gravel trucks. In this case, the remaining substrata of sand and gravel or exposed water table may be even less productive of agricultural crops. But such a soil may simply be eliminated from cultivation. It can be put to the best use suited to it and to the economy of the farm. In this sense, no soil on the farm is an entirely unproductive soil. The Emmert gravelly sandy loam is better suited to woodland and wildlife than to any other uses. Some soils, which are not naturally well suited to agricultural crops, respond remarkably to improved or intensive management; Crivitz loamy fine sand, of low natural productivity, can, with fertilization and other good management practices, be improved from an 8th to a 6th rate soil, according to Table IV, in which the rating, "1," is for a first class soil. Pence loam, a naturally more productive soil to begin with, can be improved with good management from a 6th to a 4th rate soil for hay and oats. With proper irrigation, the highest levels of crop production can be maintained year after year on a naturally droughty soil like the Pence.

Soil tests, made by the Soils Department, College of Agriculture, indicate that the plow layers of newly cleared fields are acid, and low in content of available phosphorus and potassium. See Tables XV, XVI and XVII for more information.

In some fields, fertilizer application has raised the phosphorous content to adequate levels, but the available potassium supply is inadequate still. The soils are allowed to remain acid in reaction on potato fields to help keep the crop free of infection, but alfalfa fields of dairy farms should be limed. With changes in fertilizer applications and management practices, the fertility levels of the soils change.

The general productivity ratings in Table IV are estimated on the basis of a scale of one to ten, with "1" for the soil most productive of hay and oats in the county. Soils differ as to reserves of moisture and plant nutrients which they carry in the subsoils. These differences are taken into account. To determine current crop yields for crops and management levels not shown, and to obtain current detailed recommendations, the reader will need to obtain information from proper sources, such as the office of the County Agricultural Agent, the Soils Department of the University of Wisconsin, and the Soil Conservation Service.

For best results with oats, with a legume-grass seeding, the following steps should be taken: lime and fertilize the soil according to soil test recommendations; plant clean, viable seed of adapted varieties at recommended rate; plant oats early and at the right depth. Recommendations for the production of legume-grass hay are: recommended seeding mixtures; plant only clean, viable seed of recommended varieties; if seeding is threatened by lodged oats or by drought, remove oats for silage or hay; cut hay early when it is of best quality, and cut no more than twice in one growing season in Florence County; topdress the stand each year with a maintenance application of phosphate and potash fertilizer, adding boron if needed; protect the stand from grazing and cutting from early September to mid-October (Klingelhoets and Beatty, 1961).

Soil Ratings for Engineering Uses

Although soils are used chiefly as media for plant growth, increasing acreages of soils are being used to support roads and buildings. This chapter calls attention to some differences which exist between soils in performance as supporting materials for pavement and other structures. For greater detail, the reader is referred to publications of the Portland Cement Association (1956) and the American Association of State Highway Officials (1961).

Soil bodies, like lakes, are of various sizes and shapes. But all bodies of a given kind of soil behave about the same when subjected to pressure, as under a highway. Load-carrying capacity is one of the characteristics of the soil and is expressed by the classification of the American Association of State Highway Officials (1961). Highways remain in good condition for relatively long periods of time on well-drained, permeable soils like Vilas sand. Roads deteriorate rapidly wherever they are improperly laid on imperfectly drained soils like Zim silt loam. Bodies of naturally moist or wet soils can be quickly located by means of the soil map, in conjunction with the soil keys (Figures 28 and 35). Road construction on these sites can be handled in such a way as to minimize the effects of instability inherent in these soils. It is recommended that a more detailed soil map be made especially for engineering uses along any major highway right-of-way before road construction begins. The present soil map should be used only in planning for a more detailed study of the soils and their condition, in place, at the site of each proposed structure.

The general groupings of soils in the soil keys in this bulletin can be given general interpretations with respect to engineering structures. Bodies of alluvial soils indicate sites where enginering structures need protection from flood and ice damage. Imperfectly and poorly drained silty and clayey soils, such as Cable, Auburndale, Gaastra, Tipler, Bruce, Adolph, Rudyard, Tromald, Pickford, and Bergland are likely to exhibit frost heaving wherever moisture is present during a freezing period. Roscommon and Saugatuck sands, formed from stratified deposits of lake flats and saturated with water at shallow depths, are also subject to frost action, as a result of high water table. Because bodies of representative soil series occur in repeating patterns up and down hills in a landscape, the highway engineer is confronted with a succession of soil situations which is fairly orderly. Table 1

TABLE III. SOIL PRODUCTIVITY ESTIMATES FOR HARDWOOD AND CONIFEROUS TREES IN FLORENCE COUNTY, WISCONSIN[1]

Map Symbol	Soil Name	General Soil Productivity Ratings[2]					Estimates of Soil Productivity for Specific Species and Association of Species								
		For both hard-woods and conifers	For Hardwoods		For Conifers		Aspen	Upland Hard-woods	Swamp Hard-woods	White Spruce, Balsam	Black Spruce	White Cedar	Jack Pine	White Pine	Red Pine
(15, 16)	Adolph silt loam	7	L	7	L	7	M	L	M	M	M	M	VL	M	L
3	Ahmeek silt loam	2	VH	2	VH	2	M	H	VL	H	VL	L	L	M	H
(15, 16)	Alluvial soils, un-differentiated	9	VL	9	VL	9	L	VL	H	L	M	M	VL	VL	VL
(1)	Auburndale silt loam	6	L	7	M	6	M	L	M	M	M	M	VL	M	L
(12)	Au Train loamy sand	6	L	7	M	4	M	L	L	M	VL	L	H	M	M
(15)	Bergland silty clay loam	8	L	8	L	8	M	L	M	M	M	M	VL	L	VL
(14)	Bohemian fine sandy loam	2	VH	2	VH	1	H	H	VL	M	VL	VL	L	M	H
(14, 15)	Brimley fine sandy loam	3	H	3	VH	2	VH	M	L	M	VL	VL	VL	H	M
(15)	Bruce silt loam	7	L	7	L	8	M	L	M	M	M	M	VL	L	VL
(15, 16)	Brule silt loam	3	H	3	M	4	M	M	L	M	VL	L	L	M	M
(15, 16)	Cable loam	6	L	7	M	6	M	L	M	M	M	M	VL	M	L
(5, 9, 10, 11, 12)	Crivitz loamy sand	5	L	6	M	4	H	L	VL	L	VL	VL	VH	M	M
(15)	Edwards muck	9	VL	9	VL	9	VL	VL	M	M	M	VH	VL	VL	VL
13	Emmert gravelly sandy laom	6	L	8	VH	3	L	L	VL	M	VL	L	M	L	M
14 (6)	Fence silt loam	1	VH	1	VH	2	VH	H	VL	H	VL	VL	M	M	H
(1)	Gaastra silt loam	5	M	5	H	5	VH	L	L	M	VL	VL	VL	M	VL
1, 2, (4, 5)	Goodman silt loam	1	VH	1	VH	2	VH	H	VL	M	VL	VL	M	M	H

TABLE III. SOIL PRODUCTIVITY ESTIMATES FOR HARDWOOD AND CONIFEROUS TREES IN FLORENCE COUNTY, WISCONSIN[1]—Continued

Map Symbol	Soil Name	General Soil Productivity Ratings[2]					Estimates of Soil Productivity for Specific Species and Association of Species								
		For both hard-woods and conifers	For Hardwoods		For Conifers		Aspen	Upland Hard-woods	Swamp Hard-woods	White Spruce, Balsam	Black Spruce	White Cedar	Jack Pine	White Pine	Red Pine
17	"Granitic" rock outcrops	10	VL	10	VL	10	L	VL	VL	VL	VL	VL	L	L	VL
(16)	Greenwood peat	10	VL	10	VL	10	VL	VL	VL	VL	L	VL	VL	VL	VL
(4, 5, 11, 12)	Hiawatha loamy sand	5	L	6	M	4	H	L	VL	L	VL	VL	VH	L	M
5 (4)	Hibbing silt loam	4	H	4	H	5	M	H	VL	M	VL	VL	VL	M	M
4 (1, 2, 3, 6, 9, 13, 17)	Iron River loam	2	H	3	VH	1	VH	H	VL	M	VL	VL	H	M	H
(15)	Linwood muck	10	VL	10	VL	10	VL	VL	M	M	M	L	VL	VL	VL
(5)	Manistee loamy sand	4	L	5	H	3	M	M	VL	M	VL	VL	H	M	H
(5)	Menominee loamy sand	4	L	5	H	3	M	M	VL	M	VL	VL	H	M	H
(12, 16)	Moye sandy loam	6	L	6	L	5	M	L	H	M	M	L	M	M	M
(10)	Omega loamy sand	7	L	8	M	6	L	L	VL	M	VL	VL	H	L	M
(5, 17)	Ontonagon silt loam	5	M	4	M	5	L	H	VL	L	VL	L	VL	M	M
(2, 3, 4, 6, 7, 8, 9, 10, 13)	Padus loam	2	M	4	VH	1	H	M	VL	M	VL	VL	M	L	M
4, 8, 9, 10, 12 (2, 3, 6, 7, 13, 17)	Pence sandy loam	4	L	5	VH	2	H	L	VL	M	VL	VL	VH	L	M
(15)	Pickford silty clay loam	7	L	7	M	7	M	L	M	M	M	M	VL	L	VL
(12)	Randville loamy sand	3	H	3	VH	3	M	H	VL	M	VL	VL	L	H	H
(15)	Roscommon loamy sand	9	L	9	L	8	L	VL	M	L	M	L	VL	L	VL

TABLE III. SOIL PRODUCTIVITY ESTIMATES FOR HARDWOOD AND CONIFEROUS TREES IN FLORENCE COUNTY, WISCONSIN[1]—Continued

Map Symbol	Soil Name	General Soil Productivity Ratings[2]					Estimates of Soil Productivity for Specific Species and Association of Species								
		For both hard-woods and conifers	For Hardwoods		For Conifers		Aspen	Upland Hard-woods	Swamp Hard-woods	White Spruce, Balsam	Black Spruce	White Cedar	Jack Pine	White Pine	Red Pine
(5)	Rudyard silty clay loam	6	M	6	M	6	M	M	L	M	VL	M	VL	M	L
(15)	Saugatuck sand	9	VL	9	VL	8	L	VL	L	M	M	L	L	M	L
(15, 17)	Spalding peat	10	VL	10	VL	9	VL	VL	M	M	M	L	VL	VL	VL
6, 7, 8, 9, (1, 2, 13, 14, 17)	Stambaugh silt loam	1	VH	1	VH	2	VH	H	VL	H	VL	VL	M	M	H
(5)	Superior sandy loam	4	M	4	H	4	M	H	VL	M	VL	L	VL	H	M
(14)	Tipler silt loam	5	M	5	H	5	VH	L	L	M	VL	VL	VL	M	VL
(15)	Tromald silty clay	7	L	7	M	7	M	L	M	M	M	M	VL	L	VL
5 (10)	Ubly silt loam	3	L	3	H	2	H	H	VL	M	VL	VL	H	M	M
10, 11, 12, 13 (4, 5, 6, 9, 17)	Vilas loamy sand	7	L	8	M	6	L	VL	VL	M	VL	VL	H	L	M
3 (2, 4, 5)	Wakefield loam	2	VH	1	H	2	H	VH	VL	M	VL	VL	L	M	H
(5)	Zim silty clay loam	6	M	6	M	6	M	M	L	M	VL	M	VL	M	L

Notes:
[1]These estimated yields represent current periodic growth on well-stocked, natural, mixed-age stands of woodlands under high level of management, and do not apply to plantations. Adapted from Klingelhoets and Beatty, 1961 (see bibliography), and from suggestions offered by J. W. Macon, Forestry Dept., Consolidated Water Power and Paper Co., Wisconsin Rapids, Wisconsin.
[2]Letter ratings adapted from Klingelhoets and Beatty, 1961, using symbols which are explained in their table to the right: Numerical ratings are on a basis of 1 to 10, with 1 as the symbol for highest productivity and 10 for lowest productivity.

Yield Range		Conifers		Hardwoods	
Term	Symbol	Board Feet*	Cords*	Board Feet*	Cords*
Very High	VH	Over 300	Over 0.6	Over 250	Over 0.5
High	H	250–300	0.5–0.6	200–250	0.4–0.5
Medium	M	200–250	0.4–0.5	150–200	0.3–0.4
Low	L	150–200	0.3–0.4	100–150	0.2–0.3
Very low	VL	50–150	0.1–0.3	50–100	0.1–0.2

*Board feet (Scrib. Dec. C) and Standard Cords per acre per year.

TABLE IV. SOIL PRODUCTIVITY RATING ESTIMATES FOR AGRICULTURAL USE, FLORENCE COUNTY, WISCONSIN

Map Symbol[1]	Soil Name	General Productivity Ratings[2] for Agricultural Crops	CROP PRODUCTIVITY RATINGS[3]					
			Timothy and Clover Hay (tons)	Alfalfa-Brome Hay (tons)	Oats (bu.)	Potatoes[5] (bu.)	Corn Silage[6] (tons)	Native Blue-grass Pasture[7]
(15, 16)	Adolph silt loam	10 (2)	—[4] (2.75)	— (—)	— (60)	—	— (9-12)	— (1.0)
3	Ahmeek silt loam	4 (2)	2.0 (3.0)	2.5 (3.3)	45 (70)	135 (275)	6-9 (9-12)	1.0 (2.0)
(15, 16)	Alluvial soils, undifferentiated	10 (7)	— (2.0)	— (—)	— (—)	—	— (9)	— (1.0)
(1)	Auburndale silt loam	5 (3)	1.75 (2.75)	— (3.5)	40 (60)	— (—)	6.9 (9-12)	0.75 (1.5)
(12)	Au Train loamy sand	9 (6)	— (1.25)	60 (1.5)	25 (35)	80 (175)	3 (5- 7)	0.3 (0.6)
(15)	Bergland silty clay loam	6 (3)	1.75 (2.75)	— (3.5)	35 (55)	— (—)	— (6- 9)	— (1.0)
(14)	Bohemian fine sandy loam	4 (1)	2.25 (3.0)	2.5 (3.5)	50 (75)	110 (200)	6-9 (9-12)	1.25 (2.5)
(14, 15)	Brimley fine sandy loam	4 (2)	2.0 (3.0)	— (3.5)	45 (70)	— (—)	3-6 (6- 9)	1.25 (2.5)
(15)	Bruce silt loam	5 (3)	2.0 (3.0)	— (3.5)	40 (55)	— (—)	— (—)	— (1.0)
(15, 16)	Brule silt loam	6 (4)	1.5 (2.0)	1.5 (2.5)	40 (65)	100 (230)	3-6 (6- 9)	0.5 (1.0)
(15, 16)	Cable loam	10 (3)	— (2.75)	— (2.75)	— (60)	— (—)	6-9 (9-12)	— (1.0)
(5, 9, 10, 11, 12)	Crivitz loamy sand	8 (6)	— (1.25)	1.0 (1.5)	30 (45)	95 (190)	— (6- 9)	0.25 (0.5)
(15)	Edwards muck	10 (4)	— (—)	— (—)	— (—)	— (—)	— (6- 9)	— (—)
13	Emmert gravelly sandy loam	9 (7)	0.5 (1.6)	1.0 (2.2)	25 (35)	150 (300)	— (3- 6)	0.25 (0.5)
14 (6)	Fence silt loam	4 (1)	2.25 (3.0)	2.5 (3.5)	50 (70)	140 (275)	9-12 (12-15)	1.0 (2.0)
(1)	Gaastra silt loam	5 (2)	2.0 (3.0)	— (3.5)	45 (70)	— (—)	3-6 (6- 9)	1.25 (2.5)
1, 2, (4, 5)	Goodman silt loam	4 (1)	1.8 (3.0)	2.5 (3.5)	50 (75)	140 (285)	6-9 (9-12)	1.0 (2.0)
17	"Granitic" rock outcrops	10 (-)	— (—)	— (—)	— (—)	— (—)	— (—)	— (—)
16	Greenwood peat	10 (-)	— (—)	— (—)	— (—)	— (—)	— (—)	— (—)

TABLE IV. SOIL PRODUCTIVITY RATING ESTIMATES FOR AGRICULTURAL USE, FLORENCE COUNTY, WISCONSIN—Continued

Map Symbol[1]	Soil Name	General Productivity Ratings[2] for Agricultural Crops	CROP PRODUCTIVITY RATINGS[3] Timothy and Clover Hay (tons)	Alfalfa-Brome Hay (tons)	Oats (bu.)	Potatoes[5] (bu.)	Corn Silage[6] (tons)	Native Blue-grass Pasture[7]
(4, 5, 11, 12)	Hiawatha loamy sand	9 (7)	—— (1.25)	1.0 (1.5)	20 (35)	95 (190)	—— (4–5)	0.25 (0.5)
5 (4)	Hibbing silt loam	5 (2)	2.0 (3.0)	2.0 (3.5)	45 (70)	— (—)	6–9 (9–12)	1.25 (2.5)
4 (1, 2, 3, 6, 9, 13, 17)	Iron River loam	5 (2)	1.75 (2.75)	2.0 (3.5)	45 (70)	100 (200)	6–9 (9–12)	0.75 (1.5)
(15)	Linwood muck	10 (–)	—— (—)	—— (—)	— (—)	— (—)	—— (—)	—— (—)
(5)	Manistee loamy sand	7 (5)	1.0 (1.5)	1.75 (2.5)	35 (50)	— (200)	3–6 (6– 9)	0.3 (0.75)
(5)	Menominee loamy sand	9 (6)	—— (1.2)	0.8 (1.75)	20 (40)	— (200)	2–3 (3– 6)	0.25 (0.5)
(12, 16)	Moye sandy loam	9 (4)	1.0 (1.75)	—— (2.0)	— (50)	— (—)	—— (9–12)	0.6 (1.2)
(10)	Omega loamy sand	9 (7)	—— (1.25)	1.0 (1.5)	20 (35)	— (175)	3–6 (6– 9)	0.25 (0.5)
(5, 17)	Ontonagon silt loam	5 (4)	1.75 (2.5)	2.0 (3.5)	35 (60)	— (—)	3–6 (6– 9)	1.0 (2.0)
(2, 3, 4, 6, 7, 8, 9, 10, 13)	Padus loam	5 (3)	1.5 (2.0)	1.5 (2.5)	40 (65)	100 (230)	3–6 (6– 9)	0.5 (1.0)
4, 8, 9, 10, 12 (2, 3, 6, 7, 13, 17)	Pence sandy loam	6 (4)	1.5 (1.8)	1.5 (2.5)	30 (60)	100 (200)	3–6 (6– 9)	0.5 (1.0)
(15)	Pickford silty clay	7 (3)	1.75 (2.75)	—— (3.5)	40 (55)	— (—)	—— (6– 9)	—— (1.0)
(12)	Randville loamy sand	8 (5)	—— (1.5)	0.7 (1.7)	20 (40)	— (175)	3– 5 (5– 7)	0.3 (0.6)
(15)	Roscommon loamy sand	9 (5)	1.0 (1.5)	—— (2.0)	— (45)	— (—)	—— (9–12)	1.2 (2.4)
(5)	Rudyard silty clay loam	8 (3)	—— (2.0)	—— (3.5)	35 (55)	— (—)	3–4 (4– 8)	1.2 (2.4)
(15)	Saugatuck sand	10 (9)	—— (1.2)	—— (—)	— (—)	— (—)	2 (3– 6)	0.2 (0.4)
(15, 17)	Spalding peat	10 (–)	—— (—)	—— (—)	— (—)	— (—)	—— (—)	—— (—)
6, 7, 8, 9, (1, 2, 13, 14, 17)	Stambaugh silt loam	4 (1)	2.0 (2.75)	2.0 (3.0)	50 (75)	105 (300)	3–6 (6– 9)	0.75 (1.5)
(5)	Superior sandy loam	5 (3)	1.5 (2.25)	1.5 (3.0)	35 (60)	— (—)	3–6 (6– 9)	0.5 (1.0)

TABLE IV. SOIL PRODUCTIVITY RATING ESTIMATES FOR AGRICULTURAL USE, FLORENCE COUNTY, WISCONSIN—Continued

Map Symbol[1]	Soil Name	General Productivity Ratings[2] for Agricultural Crops	CROP PRODUCTIVITY RATINGS[3] Timothy and Clover Hay (tons)	Alfalfa-Brome Hay (tons)	Oats (bu.)	Potatoes[5] (bu.)	Corn Silage[6] (tons)	Native Blue-grass Pasture[7]
(14)	Tipler silt loam	7 (1)	2.0 (3.0)	— (3.5)	45 (70)	— (—)	3-6 (6-9)	1.25 (2.5)
(15)	Tromald silty clay	5 (2)	1.75 (2.75)	— (3.5)	40 (75)	— (—)	— (6-9)	— (1.0)
5 (10)	Ubly sandy loam	7 (3)	1.0 (2.0)	1.3 (2.5)	30 (50)	100 (180)	3-6 (6-9)	0.3 (0.6)
10, 11, 12, 13 (4, 5, 6, 9, 17)	Vilas loamy sand	9 (6)	— (1.25)	1.0 (1.5)	25 (35)	— (175)	— (3-6)	0.25 (0.5)
3, (2, 4, 5)	Wakefield loam	4 (2)	2.0 (2.75)	1.75 (3.5)	45 (70)	130 (250)	3-6 (6-9)	0.75 (1.5)
(5)	Zim silty clay loam	8 (4)	1.5 (2.0)	— (3.5)	35 (55)	— (—)	3-4 (4-8)	1.2 (2.4)

Notes on Table IV

[1]Each map symbol number stands for a soil association listed in the legend of the soil map. In the first column on the left, in Table IV, a number without parentheses represents a soil association which specifically cites the soil names in the second column of the table. A number within parentheses represents a soil association which does not cite the soil in question, but which actually includes small areas of it.

[2]Soils having the highest productivity of hay and oats in the county are rated grade "1", on a scale of 1 to 10. Ratings without parentheses are for the soils under management now common in the county. Ratings in parentheses indicate estimated production of the same soils under "high management", which, for agricultural crops, includes liming and fertilizing according to soil test, maintaining optimum conditions of drainage and tilth, proper planting of good seed of most productive crop varieties, controlling diseases and harmful weeds and insects. It is apparent from the table that no soil in Florence County ranks higher than fourth under common management. Five soils rank first for hay and oats under a high level of management.

[3]Yields under high management (figures in parentheses) are for soils with adequate drainage.

[4]Dashes (—) indicate that the crop is usually not grown on the soil due to unfavorable conditions. Yields in parentheses are those resulting from high management, as contrasted with the preceding yield figures, which represent results under common management.

[5]The high-level management yields for potatoes, as given in parentheses in this column, can be approximately doubled with irrigation.

[6]Corn for grain usually does not mature in Florence County because of the short frost-free season and low summer temperatures. In years with a favorable growing season, productivity ranges from about 40 bushels under common to 75 bushels under high managements on Stambaugh silt loam; and from about 30 bushels under common to 45 bushels under high management on Omega sand.

[7]Bluegrass pastures are usually found on steeper, stonier, droughtier or wetter soils than are cultivated crops. As indicated above, production of total dry matter is approximately doubled with proper fertilization. Grazing management determines how much dry matter is recovered. For this reason pasture yield is expressed in tons per acre per year, rather than in cow-days per acre.

TABLE VA. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]

Soil Series Name	Brief Description of Typical Soil Profile	Adapted to Winter Grading	Normal Depth to Water Table (ft.)	TREATMENT: Grade: Recommended location of plan grade with respect to ground line	Grade: Recommended protection of slopes	Grade: Estimated % of Boulders (rock excavation)	Grade: Estimated depth of top-soil (ft.)	Sub-base recommended	Selected sub-base recommended	Pavement Design Index[3] Horizon B	Pavement Design Index[3] Horizon C	Hydrologic series group[10]
Adolph	Poorly drained A-4 silt loam on A-2-4 loam till	No	0.5–1.0	Fill 4′–5′ (minimum)	Seed[2]	0.2[2]	.5–.8	Yes	--------	14	14	D
Ahmeek	2′–3.5′ silt loam on stony loam till. Stoniness obstructs fine grading.	Fair	5–15	Influenced by bedrock	No	2.0	.2–.4	Yes	--------	12	2	B
Alluvial soils, undifferentiated	Poorly drained loams	No	0.5–2.0	Fill 4′–5′ (minimum)	Seed[2]	0.0	.4–.7	Yes	--------	15	15	D
Auburndale	2′–3.5′ poorly drained silt loam over loam till	No	1–2	Fill 3′–4′[4]	Seed[2]	0.0	.4–.7	Yes	--------	14	14	D
Au Train	Well drained sand plains	Good	Deep	Anywhere	Plant	0.0	.1–.3	No[6]	Yes	5	0	B
Bergland	Poorly drained clay	No	Shallow	Fill 4′–5′[4]	Seed[2]	0.0	.7–1.0	Yes	--------	14	12	D
Bohemian	Upland deposits of fine sand and silt, stratified	Poor	Indefinite (seepage)	Anywhere	F.S. & M.[5]	0.0	.3–.5	Yes	--------	14	14	B
Brimley	Imperfectly drained very fine sand and silt, stratified	No	2–3	Fill 2′–3′[4]	Seed	0.0	.4–.7	Yes	--------	14	14	C
Bruce	Poorly drained fine sand and silt	No	0.5–1.0	4′–5′[4]	Seed[2]	0.0	.5–.8	Yes	--------	14	14	D
Brule	Stream bottom	Fill always required	Subject to overflow		Seed[2]	0.0	Variable	Yes	--------	12	14	C
Cable	Poorly drained silt loam	No	1–2	Fill 3′–4′[4]	Seed[2]	0.0	.4–.7	Yes	--------	14	14	D
Crivitz	1′–2′ of well drained loamy sand over sand and gravel	Excellent	Deep	Anywhere	F.S. & M.[5]	0.1	.1–.4	No	Yes	2	0	B
Edwards	Muck over marl, very poorly drained	This soil to be excavated and wasted			------------	0.0	Variable	Yes	--------	--------	--------	--------

TABLE VA. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	Brief Description of Typical Soil Profile	Adapted to Winter Grading	Normal Depth to Water Table (ft.)	TREATMENT: Grade: Recommended location of plan grade with respect to ground line	TREATMENT: Grade: Recommended protection of slopes	TREATMENT: Grade: Estimated % of Boulders (rock excavation)	TREATMENT: Grade: Estimated depth of top-soil (ft.)	TREATMENT: Sub-base recommended	TREATMENT: Selected sub-base recommended	TREATMENT: Pavement Design Index[3]: Horizon B	TREATMENT: Pavement Design Index[3]: Horizon C	Hydrologic series group[10]
Emmert	Stony, loamy sand, rough topography	Excellent	Deep	Anywhere	T.S.[8]	2.5	.2–.4	No[6]	Yes	0	0	A
Fence	Moderately well drained deep silts and very fine sands	Poor	Indefinite (seepage)	Anywhere	F.S. & M.[5]	0.1–1.0	.3–.5	Yes	--------	14	14	B
Gaastra	3′–5′ imperfectly drained silt over stony loam till	No	2′–3′	Fill 2′–3′[4]	Seed	0.0	.4–.7	Yes	--------	14	4	C
Goodman	2′–3.5′ well drained silt loam over stony loam till, rolling	Fair	Deep	Anywhere	F.S. & M.[5]	1.0	.3–.6	Yes	--------	14	2	B
"Granitic" rock outcrop	Bedrock knobs with shallow soil in patches	Cuts through rock may be required			Variable	Much solid rock	0–.3	No	--------	--------	--------	--------
Greenwood	Peat, very poorly drained	This soil to be excavated and wasted			--------	0.0	Variable	Yes	--------	--------	--------	--------
Hiawatha	Well drained sand, level to hilly topography	Excellent	Deep	Anywhere	Plant	0.1	.1–.3	No[6]	Yes	2	0	A
Hibbing	0.6′ well drained silt or fine sandy loam over silty clay loam, level to rolling	No	Deep	Anywhere	F.S. & M.[5]	0.1	0.4–0.7	Yes	--------	14	12	C
Iron River	<2′ of well drained silt loam over stony, sandy drift. Stoniness obstructs fine grading	Good	Deep	Anywhere	F.S. & M.[5]	1.0	.3–.6	No[6]	No	10	2	B
Linwood	Muck, very poorly drained	This soil to be excavated and wasted			--------	0.0	Variable	Yes	--------	--------	--------	--------
Manistee	1.5′–3.5′ of loamy sand over clay	Poor	Deep[9]	Anywhere	Seed[2]	0.0	.2–.5	Yes	--------	5	12	C
Menominee	1.5′–3.5′ moderately well drained loamy sand over clay loam till	No	Deep[9]	Anywhere	F.S. & M.[5]	0.1	1.0–0.5	Yes	--------	5	12	C

TABLE VA. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	Brief Description of Typical Soil Profile	Adapted to Winter Grading	Normal Depth to Water Table (ft.)	TREATMENT								
				Grade				Sub-base recom-mended	Selected sub-base recom-mended	Pavement Design Index[3]		Hydro-logic series group[10]
				Recommended location of plan grade with respect to ground line	Recom-mended protection of slopes	Estimated % of Boulders (rock excavation)	Estimated depth of top-soil (ft.)			Horizon		
										B	C	
Moye	Imperfectly drained sandy loam 1.5′–2.5′ thick over fine sand	No	2′–3′	Fill 2′–3′	F.S. & M.[5]	0.0	.4–.7	Yes	--------	14	14	C
Omega	Deep sand, level to hilly	Excellent	Deep	Anywhere	F.S. & M.[5]	0.1	.3–.3	No	Yes	0	0	A
Ontonagon	Red clay plains	No	Indefinite (seepage)	Determined by surface drainage[4]	T.S.[8]	0.0	.3–.6	Yes	--------	14	12	C
Padus	2′–3.5′ well drained sandy loam over sand and gravel	Good	Deep	Anywhere	F.S. & M.[5]	0.0	.1–.3	No[6]	Yes	10	0	B
Pence	1.4′–2′ of well drained sandy loam over sand and gravel	Excellent	Deep	Anywhere	F.S. & M.[5]	0.0	.1–.4	No[6]	Yes	8	0	B
Pickford	Poorly drained clay plains	No	Indefinite (seepage)	Determined by surface drainage[4]	T.S.[8]	0.0	.4–.7	Yes	--------	14	12	D
Randville	Well drained loamy sand, level to hilly	Good	Deep	Anywhere	F.S. & M.[5]	0.0	.1–.3	No	Yes	2	0	A
Roscommon	Poorly drained sand	No	0′–1′	Fill 4′–5′ (minimum)	Seed[2]	0.0	.5–.9	No	Yes	0	0	D
Rudyard	Imperfectly drained clay plains	No	Indefinite (seepage)	Determined by surface drainage[4]	T.S.[8]	0.0	.4–.7	Yes	--------	14	12	D
Saugatuck	Poorly drained sand	Poor	2′–3′	Fill 3′–4′ (minimum)	Seed[2]	0.0	.2–.5	No	Yes	0	0	D
Spalding	Peat, very poorly drained	This soil to be excavated and wasted			------------	0.0	Variable	Yes	--------	--------	--------	--------
Stambaugh	2′–3.5′ of silt loam over sand and gravel	Fair	Deep	Anywhere	F.S. & M.[5]	0.0	0.2–.5	No[6]	No	14	0	B

TABLE VA. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	Brief Description of Typical Soil Profile	Adapted to Winter Grading	Normal Depth to Water Table (ft.)	TREATMENT: Grade: Recommended location of plan grade with respect to ground line	TREATMENT: Grade: Recommended protection of slopes	TREATMENT: Grade: Estimated % of Boulders (rock excavation)	TREATMENT: Grade: Estimated depth of top-soil (ft.)	TREATMENT: Sub-base recommended	TREATMENT: Selected sub-base recommended	TREATMENT: Pavement Design Index[3]: Horizon B	TREATMENT: Pavement Design Index[3]: Horizon C	TREATMENT: Hydrologic series group[10]
Superior	.5'-3' of sandy material over clay	Poor	Indefinite (seepage)	Determined by surface drainage	T.S.[8]	0.0	.3-.6	Yes	--------	14	12	C
Tipler	Imperfectly drained deep silts and fine sands	No	2'-3'	Fill 2'-3'[4]	Seed	0.0	.4-.7	Yes	--------	14	14	C
Tromald	Poorly drained clay plains	No	Indefinite (seepage)	Determined by surface drainage[4]	T.S.[8]	0.1	.4-.7	Yes	--------	14	12	D
Ubly	1.5'-3.5' sandy loam on loam and silty clay loam	Poor	Deep	Anywhere	T.S.[8]	0.0	.3-.6	Yes	--------	5	12	C
Vilas	Deep sand, level to hilly	Excellent	Deep	Anywhere	F.S. & M.[5]	0.2	.1-.4	No	Yes	0	0	A
Wakefield	Well drained sandy loam upland	No	Deep	Anywhere (bed-rock limitations)	F.S. & M.[5]	1.0	.2-.6	Yes	--------	14	14	C
Zim	Imperfectly drained clay plains	No	Indefinite (seepage)	Determined by surface drainage	T.S.[8]	0.1	.4-.7	Yes	--------	14	12	D

TABLE VB. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	TREATMENT							RESOURCES			
	Estimated lineal feet per 1000 ft. of cut below natural ground elevation				Embankment						
	Frost heave excavation	Edge drains	Bank drains								
	per 1000 ft. of roadbed		Use only if cut deeper than (ft.)	Lineal feet per 1000 ft.	Suitable borrow	Recommended method of restoring borrow pits where restoration is necessary	% of Shrinkage	Porous material Grade A	Possible source gravel	Possible source sand	Source of Topsoil
Adolph	400[2]	1,000[2]	----------	----------	No	----------	20-30	No	No	No	Fair
Ahmeek	300	400	----------	----------	Limited	F.S. & M.[5]	10-20	No	No	No	No
Alluvial soils, undifferentiated	500[2]	1,000[2]	----------	----------	No	----------	20-30	No	No	No	Fair
Auburndale	600	1,000	4	>1,200	No	----------	20-30	No	No	No	Fair
Au Train	100	0	15	500	Yes	Plant	10-20	Yes	No	Yes	No
Bergland	400[2]	600[2]	----------	----------	No	----------	20-30	No	No	No	Fair
Bohemian	900	900	7	800	Yes[11]	F.S. & M.[5]	20-30	No	No	No	Fair
Brimley	800[2]	1,000[2]	5[2]	>1,200	No	----------	20-30	No	No	No	Fair
Bruce	800	1,000	5	1,200	No	----------	20-30	No	No	No	Good
Brule	400[2]	1,000[2]	----------	----------	No	----------	25-35	No	No	No	Fair
Cable	600	1,000	4	>1,200	No	----------	20-30	No	No	No	Fair
Crivitz	150	150	----------	----------	Yes	Plant[7]	15-25	Yes	No	Yes	No
Edwards	----------	----------	----------	----------	No	----------	60-70	No	No	No	Poor
Emmert	200	200	----------	----------	Yes	Plant[7]	10-20	Yes	Yes	Yes	No
Fence	800	800	7	800	Yes	F.S. & M.[5]	20-30	No	No	No	Good
Gaastra	800	1,000	5	>1,200	No	----------	20-30	No	No	No	Fair
Goodman	300	300	----------	----------	Yes	F.S. & M.[5]	20-30	No	No	No	Good

TABLE VB. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	TREATMENT: Estimated lineal feet per 1000 ft. of cut below natural ground elevation				TREATMENT: Embankment			RESOURCES			
	Frost heave excavation (per 1000 ft. of roadbed)	Edge drains (per 1000 ft. of roadbed)	Bank drains: Use only if cut deeper than (ft.)	Bank drains: Lineal feet per 1000 ft.	Suitable borrow	Recommended method of restoring borrow pits where restoration is necessary	% of Shrinkage	Porous material Grade A	Possible source gravel	Possible source sand	Source of Topsoil
"Granitic" rock outcrop	----	----	----	----	No	----	----	No	No	No	No
Greenwood	All	1,000[7]	----	----	No	----	60-70	No	No	No	Poor
Hiawatha	300	300	----	----	Yes	Plant[6]	10–20	Yes	No	Yes	No
Hibbing	300	400	----	----	Yes	F.S. & M.[5]	20–30	No	No	No	Good
Iron River	200	300	----	----	Yes	F.S. & M.[5]	20–30	Yes	No	Fair	Fair
Linwood	----	----	----	----	No	----	60–70	No	No	No	Poor
Manistee	300	500	3	300	Limited	Seed	15–25	Limited	No	Fair	Fair
Menominee	300	500	3	300	Yes	F.S. & M.[5]	20–30	No	No	No	No
Moye	800[2]	1,000[2]	5[2]	>1,200	No	----	20–30	No	No	No	Fair
Omega	300	300	----	----	Yes	Plant[7]	10–20	Yes	No	Yes	No
Ontonagon	300	500	----	----	No	----	25–35	No	No	No	Good
Padus	100	100	----	----	Yes	Plant[7]	15–25	Yes	No	Yes	Fair
Pence	100	100	----	----	Yes	Plant[7]	15–25	Yes	No	Yes	Fair
Pickford	500	800	----	----	No	----	25–35	No	No	No	Good
Randville	200	300	----	----	Yes	Plant[7]	10–20	Fair	No	Yes	No
Roscommon	100[2]	1,000[2]	5[2]	1,200	Yes (under water)	----	15–25	No	No	Yes	Poor
Rudyard	400	700	----	----	No	----	25–35	No	No	No	Good

TABLE VB. HIGHWAY ENGINEERS' DESIGN RECOMMENDATION CHART[1]—Continued

Soil Series Name	TREATMENT: Estimated lineal feet per 1000 ft. of cut below natural ground elevation — Frost heave excavation (per 1000 ft. of roadbed)	Edge drains (per 1000 ft. of roadbed)	Bank drains: Use only if cut deeper than (ft.)	Bank drains: Lineal feet per 1000 ft.	Embankment: Suitable borrow	Embankment: Recommended method of restoring borrow pits where restoration is necessary	Embankment: % of Shrinkage	RESOURCES: Porous material Grade A	Possible source gravel	Possible source sand	Source of Topsoil
Saugatuck	300[2]	600[2]	7	800	Limited	----------	10–20	No	No	Yes	Poor
Spalding	All	1,000	----------	----------	No	----------	60–70	No	No	No	Poor
Stambaugh	100	100	20	500	Yes	Plant[7]	15–25	Yes	Fair	Fair	Fair
Superior	400	500	----------	----------	No	----------	25–35	No	No	No	Fair
Tipler	800	1,000	5	>1,200	No	----------	20–30	No	No	No	Fair
Tromald	500	800	----------	----------	No	----------	25–35	No	No	No	Good
Ubly	400	500	3	300	Limited	F.S. & M.[5]	15–25	No	No	Fair	Poor
Vilas	200	200	----------	----------	Yes	Plant[7]	10–20	Yes	No	Yes	No
Wakefield	400	600	----------	----------	Yes	F.S. & M.[5]	20–30	No	No	No	Fair
Zim	400	700	----------	----------	No	----------	25–35	No	No	No	Good

Notes:
1 Adapted from work of R. Keyser, 1961, and Michigan State Highway Department, (1960).
2 These items apply only where standards of vertical alignment require cut sections in variance with recommendations in first column under "Grade".
3 Pavement Design Indices range from 0 to 20, the lower numbers representing the most favorable subgrade conditions and the higher numbers representing the least favorable subgrade conditions.
4 Sand core fill recommended.
5 F.S. & M.=fertilize, seed and mulch on all 1 on 4 slopes or flatter and also, on 1 on 2 slopes through shallow cuts and fills. The 1 on 2 slopes through deeper cuts and fill areas should be sodded.
6 Subbase recommended if grade line is in "B" horizon (upper 3 feet of profile).
7 Plant collected stock.
8 Add topsoil and seed.
9 Occasional perched water-table.
10 There are four hydrologic soil groups (A, B, C, D), ranging from soils having high infiltration rates when thoroughly wetted (A) to soils having very slow infiltration rates when thoroughly wetted (D).
11 Borrow material from this soil should be placed more than 5 feet below elevation of plan grade.

TABLE VI. SOME ENGINEERING PROPERTIES OF SOME SOILS OF FLORENCE COUNTY, WISCONSIN[1]

Soil Series Name	Soil Horizon	% of Soil Passing[2]			Clay (%) <0.005 mm	Colloids (%) <0.001 mm	Liquid[3] Limit	Plasticity[4] Index	AASHO[5] Class
		#10 Sieve	#40 Sieve	#200 Sieve					
Ahmeek	C	91	82	46	10	2	—	NP	A-4 (2)
Goodman	B_2	93	85	62	17	10	20	4	A-4 (5)
	C	79	62	18	6	3	—	NP	A-2-4 (0)
	C_2	79	62	22	7	4	—	NP	A-2-4 (0)
Iron River	C	64	51	22	5	3	—	NP	A-2-4 (0)
Monico	B_2	90	76	36	11	4	—	NP	A-2-4 (0)
	C	82	66	27	8	5	—	NP	A-2-4 (0)
Omega	C	100	99	12	0	0	—	NP	A-2-4 (0)
Ontonagon	C	100	98	89	64	40	49	27	A-7-6 (17)
Stambaugh	B_2	100	96	70	17	11	22	4	A-4 (7)
	C	100	95	65	15	10	21	5	A-4 (6)

[1]The data are provided by Dr. R. H. Keyser, College of Engineering, University of Wisconsin, Madison.
[2]The sieves named below have openings as follows: #10=2.0 mm; #40=0.42 mm; #200=0.074 mm.
[3]Liquid Limit is defined as the moisture content at which a soil changes from a plastic to a liquid state.
[4]Plasticity Index is defined as the numerical difference between liquid limit and plastic limit. The plastic limit is the moisture content at which a soil changes from a semisolid to a plastic state. NP. stands for "nonplastic", which means either that the plastic limit is equal to or higher than the liquid limit, or that these limits cannot be determined.
[5]AASHO class refers to the soil classification by the American Association of State Highway Officials (1961), which has been briefly summarized by the Portland Cement Association (1956).

shows that soil series are related to each other in dry-to-wet sequences, such as the Goodman-Gaastra-Auburndale-Adolph sequence.

V. HOW THE SOILS FORMED IN FLORENCE COUNTY, WISCONSIN

The climate and vegetation of Florence County have caused the soils to develop very differently from soils in other climatic and vegetational zones, as in southwestern Wisconsin (Hole, 1956). Differences between soils within the county may be traced, in many instances, to differences in parent materials or in topography. The maps in this section of the report help explain the formation of soils of Florence County, Wisconsin. This discussion will be concerned with: (1) factors of soil formation in Florence County, and (2) the effects of these factors on a typical well drained soil.

Factors of Soil Formation in Florence County

Geologic materials, topography, climate, and organisms have acted through space and time to form the soils we see today in the county.

GEOLOGIC FORMATIONS: Bedrock. By Carl E. Dutton, U. S. Geological Survey.

Florence County lies within the southern extension of the Canadian Precambrian Shield. The known bedrock is all of Precambrian age and comprises the formations shown on the map (Figure 8) and in Table VII. Outcrops are widely distributed and locally numerous in the eastern part of the county; but little is known of the geology in the western part because exposures are so few and widely scattered. The formations consist of sedimentary and volcanic rocks that have been intensely folded and are steeply inclined. Several faults are indicated by the surface distribution of the rocks. Although there is some evidence that sandstones of Cambrian age covered the county millions of years ago (Hamblin, 1961), they have long since been removed by erosion.

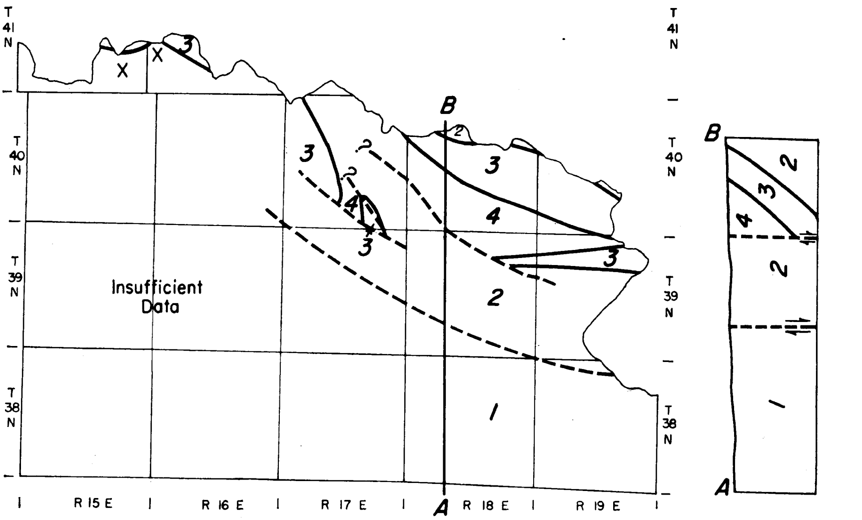
Locally altered and enriched parts of iron-bearing formation near Florence were mined for iron ore of moderate iron content and relatively high phosphorous content. The great variety of minerals in the sandy soils of the county is derived from the wide range of metamorphosed sedimentary and igneous rocks.

SURFICIAL DEPOSITS. Thousands of years ago continental glaciers or ice-sheets moved across the area now called Florence County. Perhaps 16,000 years ago the ice advance, during the Cary substage of the Wisconsin stage of Pleistocene glaciation, undoubtedly covered deposits and ice blocks left by previous ice advances. The general flow of ice was from northeast to southwest, as indicated by drumlin-like hills and other molded forms, and by eskers, esker-like ridges, and other stagnation features (see Figure 25).

The ice left several kinds of deposits as follows: (1) unsorted debris called "till," deposited directly from the ice with little or no reworking by water; (2) sorted and stratified water-laid glacial deposits (glacio-fluvial

GENERALIZED MAP AND SECTION OF PRECAMBRIAN BEDROCK OF FLORENCE COUNTY, WISCONSIN

by Carl E. Dutton



1 VOLCANIC ROCKS

2 SLATE, GRAYWACKE, QUARTZITE, CONGLOMERATE; LOCALLY IRON FORMATION AND DOLOMITE (X)

3 VOLCANIC ROCKS

4 SLATE, GRAYWACKE, AND IRON FORMATION

0 5 MILES
0 8 KM

Figure 8.

TABLE VII. SEQUENCE OF PRECAMBRIAN ROCKS IN FLORENCE COUNTY, WISCONSIN

System and Series			Map Symbol (fig. 8)	Lithology	Estimated thickness
PRECAMBRIAN	Middle Precambrian	Animikie Series	4	Slate, graywacke, and iron-formation	5,000 feet
			3	Volcanic rocks (low-grade metamorphosed basaltic flows and tuff)	As much as 15,000 feet
			2	Slate, graywacke, quartzite, and conglomerate; locally iron-formation, also dolomite (at x, in fig. 8)	More than 5,000 feet
	Lower Precambrian		1	Volcanic rocks (intermediate grade metamorphosed basaltic flows and some rhyolitic rock) intruded by post-Animikie granitic and metamorphosed gabbroic rocks (not shown on map)	Probably more than 10,000 feet

inwash and outwash deposits) including (a) sand and gravel deposits from rapidly flowing melt-waters, and (b) fine sand, silt, and clay deposits in relatively quiet waters. The glacio-fluvial deposits may be subdivided on the basis of topography into unpitted and pitted. The pitted deposits at one time contained buried ice blocks (Thwaites, 1926), which eventually melted, leaving the pits. These are called kettles or, if occupied by water, kettle lakes. The map in Figure 25 shows the location of some of these features, including about 150 esker-like ridges and 830 kettles or natural pits not occupied by lakes, and 80 lakes, most of which occupy kettles.

The glacial till in the county ranges from clayey deposits, chiefly in southeastern Florence County, and in the vicinity of bodies of iron-formation, to stony and sandy deposits. In western townships, coarse outwash sand and gravel deposits are capped in many places by a coarse, till-like layer about a foot thick.

Although bedrock outcrops are numerous enough in southeastern Florence County (see Figure 8) so that unit number 17 on the soil map is labeled "Granitic Rockland," glacial drift in the vicinity of Florence attains thicknesses as great as 265 feet, in a valley fill in a buried preglacial channel.[1]

The glacier brought rock material, including scattered stones of dolomitic limestone, from Canada and the northern peninsula of Michigan. However, the bulk of the material in the glacial drift is probably of local origin.

Across the hills and plains left by the glacier, winds deposited locally a silty material in a blanket as thick as three or four feet. The coarse silt deposit, referred to as "loess," is found chiefly in western portions of the county. Where silt covers sandy or stony glacial drift, soil resources for agricultural crops and hardwood-conifer forests are improved.

TOPOGRAPHY AND NATURAL DRAINAGE. Elevations listed by Martin (1932) include these: Commonwealth, 1,315; Florence, 1,290; Lindels, 1,501; Long Lake, 1,526; Twin Falls, 1,100. The range in elevation is from 1,100 feet above sea level at the head of Twin Falls in eastern Florence County to 1,526 feet at Long Lake in the west, a difference of 426 feet. The map in Figure 25 gives a general picture of the county, including the drainage pattern. The water supply is abundant in the glacial drift, but less so in the jointed crystalline bedrock. Depth to ground water ranges to as much as 125 feet but is commonly about 30 feet. Water is soft in the western half of the county, with 121 parts per million (ppm) of mineral content in surface wells and 135 ppm in rock wells. In the eastern half of the county, surface well waters have about 224 ppm and rock wells 216 ppm. These are considered "medium hard" waters. However, at depths, parts of Florence County are underlain by formations containing stagnant, saline water.[1] Natural drainage ranges from excessive, as in droughty sands

[1] Personal communication from L. R. Holt, Jr., District Geologist, Ground Water Branch, U. S. Geological Survey, Madison, Wisconsin.

southwest of Spread Eagle in eastern Florence County, to very poor in the peat bogs, which cover about 14 per cent of the county.

More than 80 lakes are represented on the soil map. Surface water flows from Florence County eastward through the Brule, Pine, Popple, and Pemebonwon Rivers to the Menominee River which empties into Green Bay of Lake Michigan in the St. Lawrence River drainage system.

Land forms in Florence County are of glacial origin, but in eastern portions of the county considerable control of topography by bedrock is evident. In Figure 25, the northwest to southeast orientation of swamps and some tributaries, in T. 38 N., R. 18 and 19 E., parallels the bedrock units.

CLIMATE. Florence County has a humid, continental, cool-summer climate. The county lies near the northwestern limit of the humid climatic zone of eastern North America, about 250 miles northeast of the border of the subhumid zone of the prairies, and about the same distance south of the cool-summer subarctic zone of the forests of Canada. In terms of soil geography, the county is in the zone of Podzol soils, the southwestern boundary of which extends in Wisconsin approximately from Ashland to Green Bay. The average snow fall is about 60 inches and snow covers the landscape approximately 125 days out of the year. Of the approximately 30 inches of

TABLE VIII. CLIMATIC DATA FOR BRULE ISLAND, FLORENCE COUNTY, WISCONSIN[1]

(Based on 31 years records, 1922 to 1952, for precipitation; 16 years records, 1937 to 1952, for temperature)

Months	Average Temperature, °F			Average Precip., Inches		Heat Units[2]		
	Max.	Min.	Mean	Total Precip.	Snowfall	50	40	32
Spring:[3]	54.1	25.2	39.6	7.04	15.4	84	412	900
March	39.3	12.0	25.6	1.60	10.0	0	0	0
April	54.9	26.2	40.6	2.24	5.3	0	18	258
May	68.1	37.3	52.7	3.20	0.1	84	394	642
Summer:	78.5	49.3	63.9	11.26	T	1281	2201	2937
June	75.9	46.9	61.4	4.18	T	342	642	882
July	80.7	51.2	66.0	3.78	0	496	806	1054
August	78.9	49.8	64.3	3.30	0	443	753	1001
Autumn:	56.4	32.0	44.2	7.65	7.2	177	654	1142
Sept.	69.9	41.9	55.9	3.49	T	177	477	717
Oct.	58.9	32.5	45.7	2.05	0.9	0	177	425
Nov.	40.4	21.6	31.0	2.11	6.3	0	0	0
Winter:	27.9	5.4	16.6	4.01	39.0	0	0	0
Dec.	29.1	10.4	19.7	1.30	12.2	0	0	0
Jan.	25.5	2.4	13.9	1.38	14.5 (?)	0	0	0
Feb.	29.2	3.3	16.2	1.33	12.3	0	0	0
Annual	54.2	28.0	41.1	29.96	61.6	1542	3267	4979

[1]Prepared by Prof. J. Y. Wang, Departments of Meteorology and Soils, University of Wisconsin.

[2]Three threshold values, 50°F, 40°F, and 32°F, are used in computing the accumulated heat units. They may be read as the number of degrees above 50°F (or the threshold temperature), etc. They are computed from the mean monthly temperature, T_m, number of days in the month, D, and the threshold temperature, T_b, according to the formula: Heat units $= (T_m - T_b)D$.

[3]All seasonal values for temperatures are the mean values for the particular season concerned, but for precipitation and heat units, they are accumulated values.

TABLE IX. CLIMATIC DATA FOR BREAK WATER, FLORENCE COUNTY, WISCONSIN[1]

(Based on 30 years records, 1923 to 1952)

Months	Average Precipitation in Inches	
	Total Precip.	Snowfall
Spring:	6.77	15.3
March	1.55	10.8
April	2.13	4.4
May	3.09	0.1
Summer:	10.40	T
June	3.76	T
July	3.29	T
August	3.35	0
Autumn:	7.28	6.7
Sept.	3.12	T
Oct.	2.02	0.8
Nov.	2.14	5.9
Winter:	3.64	37.3
Dec.	1.20	11.5
Jan.	1.25	13.2
Feb.	1.19	12.6
Annual	28.09	59.3

[1]Prepared by Professor J. Y. Wang, Departments of Meteorology and Soils, University of Wisconsin.

TABLE X. CLIMATIC DATA FOR FLORENCE, FLORENCE COUNTY, WISCONSIN[1]

(Based on 42 years records, 1891 to 1932, for both temperature and precipitation)

Months	Average Temperature, °F			Average Precipitation, Inches		Heat Units[2]		
	Max.	Min.	Mean	Total Precip.	Snowfall	50	40	32
Spring:[3]	50.1	26.6	38.4	7.33	17.7	40	350	811
March	35.0	14.1	24.7	1.74	11.5	0	0	0
April	50.8	27.6	39.1	2.45	5.9	0	0	213
May	64.6	38.2	51.3	3.14	0.3	40	350	598
Summer:	76.9	50.7	63.8	11.27	0	1268	2188	2924
June	75.3	48.6	61.9	3.77	0	357	657	897
July	79.3	53.1	66.1	4.06	0	499	809	1057
August	76.2	50.4	63.3	3.44	0	412	722	970
Autumn:	54.4	33.8	44.1	7.81	8.2	192	641	1129
Sept.	68.1	44.2	56.4	3.36	T	192	492	732
Oct.	55.8	34.4	44.8	2.42	0.7	0	149	397
Nov.	39.3	22.8	31.0	2.03	7.5	0	0	0
Winter:	24.3	5.6	14.9	3.90	33.6	0	0	0
Dec.	26.3	10.1	18.3	1.38	10.1	0	0	0
Jan.	21.9	3.2	12.3	1.17	11.2	0	0	0
Feb.	24.6	3.5	14.0	1.35	12.3	0	0	0
Annual	51.4	29.2	40.3	30.31	59.5	1500	3179	4864

[1]Prepared by J. Y. Wang, Departments of Meterology and Soils, University of Wisconsin.
[2]Three threshold values, 50°F, 40°F, and 32°F, are used in computing the accumulated heat units. They may be read as the number of degrees above 50°F (or the threshold temperature), etc. They are computed from the mean monthly temperature, T_m, the number of days in the month, D, and the threshold temperature, T_b, according to the formula: Heat units = $(T_m - T_b)D$.
[3]All seasonal values for temperatures are the mean values for the particular season concerned, but for precipitation and heat units, they are accumulated values.

TABLE XI. CLIMATOLOGICAL STATION INDEX OF FLORENCE COUNTY, WISCONSIN

Prepared January, 1960

Station Designation	Location		Elevation	Years of continuous record		Remarks
	Lat., N.	Long., W.		Precip.	Temp.[1]	
Break Water	45° 50′	88° 15′	1140 ft.	38	----------	to present
Brule Island	45° 57′	88° 13′	1250 ft.	38	24	to present
Florence	45° 54′	88° 16′	1290 ft.	44	44	closed on 8/31/35

[1] Record was kept of maximum and minimum temperatures.

annual precipitation, about 17 inches are lost through evaporation and transpiration, leaving 13 inches for ground water storage and stream flow.

The average frost-free season ranges from 107 to 119 days. Bogs and marshes have summer night frosts. Average winter frost penetration in open fields is about 36 inches, but under forest cover with undisturbed natural litter on the forest floor, frost may extend only 6 inches into the soil. The last killing frost in the spring in Florence, Wisconsin occurs on the average about May 29 (Hole and Lee, 1955), although ten per cent of the time it is as late as June 15. The first fall frost comes September 18, on the average, but ten per cent of the time it may come as early as August 29. According to *Climate and Man* (U.S.D.A., 1941), temperatures as high as 104° F. and as low as –39° F. have been recorded in the county. There are about 30 days each year with thunderstorms, some of which produce rainfall intensities as high as 1.7 inches per hour. There is hail on the average of about 2 days annually. There are on the average 100 clear days each year, and 12 days with dense fog. On a winter day there are on the average 3.5 hours of sunshine, about 40 per cent of the possible sunshine. In summer, there are on the average 9.4 hours of sunshine daily, or about 62 per cent of the possible sunshine.

Tables VIII through XI, prepared by Professor J. Y. Wang of the Department of Meteorology of The University of Wisconsin at Madison, give information on the location and years of activity of three climatological stations in the county, and summaries of the data obtained, including heat units which express growing-degree days.

ORGANISMS. The distribution of original vegetation in Florence County, as of about 1850, is shown in Figure 9, based on work by Professor R. W. Finley. The sugar maple-yellow birch-hemlock-pine forest association is the most extensive. Evidences of windfall of trees, very likely during a single wind storm, were recorded in the northwest part of the county in this association. Swamp forest was found scattered throughout the county, and the larger bodies are shown on the map. Pine forest was most extensive in the eastern portions of the county.

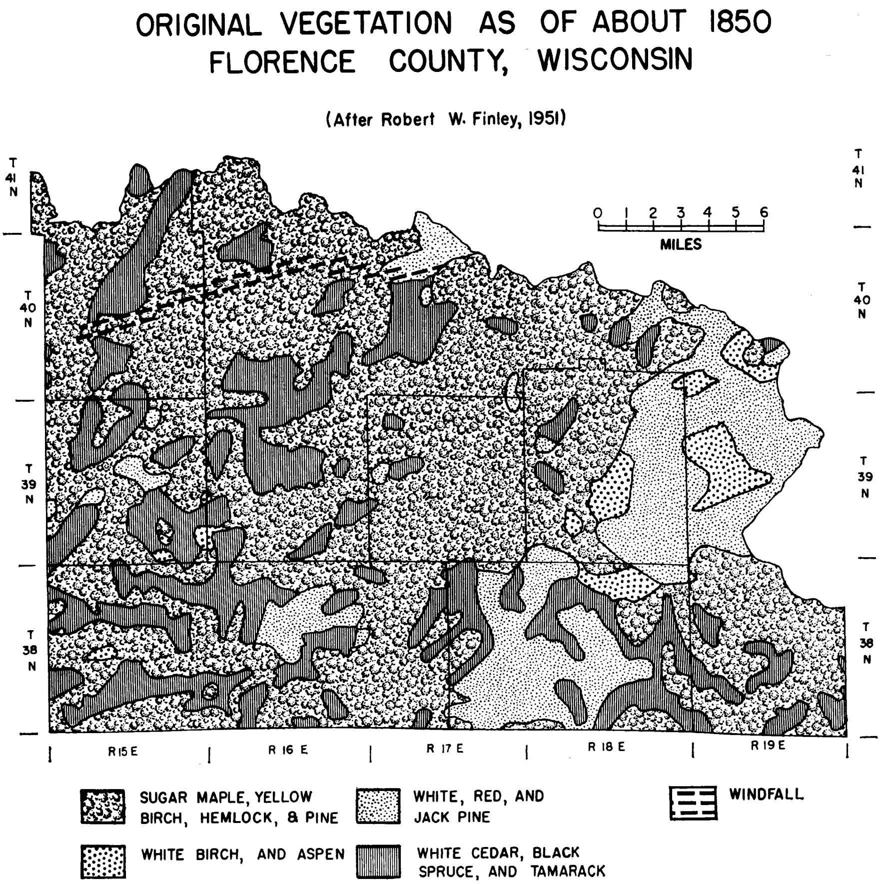


Figure 9.

The generalized forest cover type map (Figure 10), supplied by the Wisconsin Conservation Department, shows the situation in 1956, after the period of logging in the latter part of the 19th century and early part of this century. Lumber operations continue on a scientific basis in the northern hardwood forest of west central Florence County. "Maple blight" possibly caused by a combination of severe insect infestation and disease has at times reduced the value of the timber locally.

The pine and hardwood forests produce a forest litter which becomes fungus infested, and through which water percolates, carrying organic compounds which help to move iron and clay down to the coffee-brown B horizon, leaving a bleached A_2 horizon above (see Figure 2). Disturbance of the soil by fire, wind, and water erosion, tree throw, and activity of small and large animals, including man, can destroy or can prevent the forma-

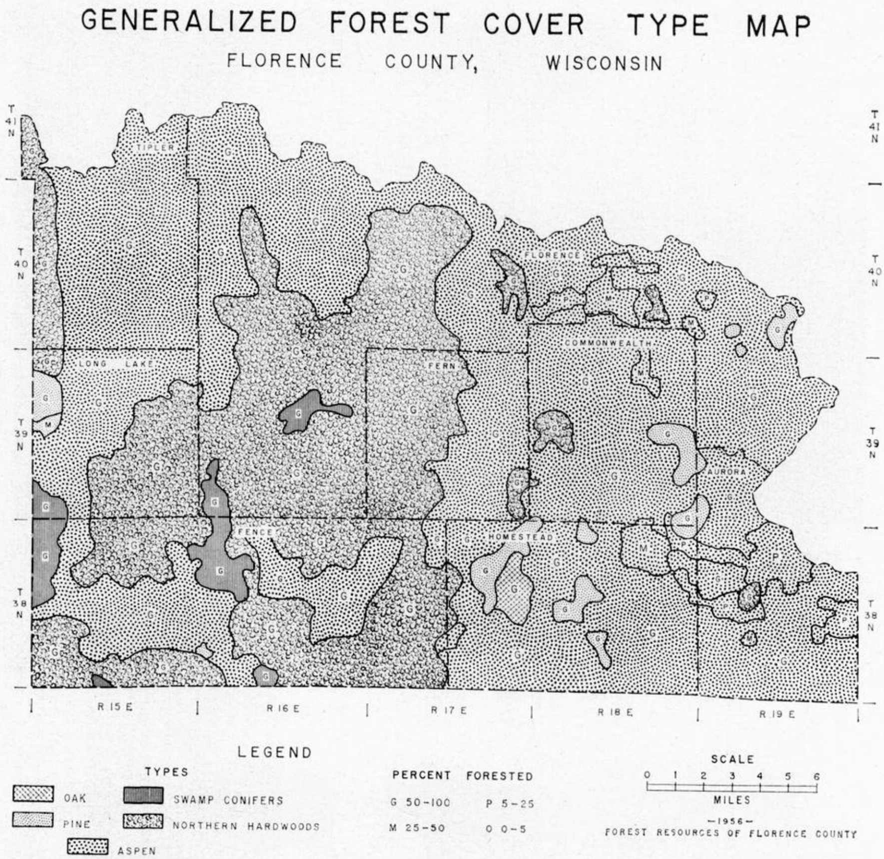


Figure 10. **(Prepared by the Wisconsin Conservation Department.)**

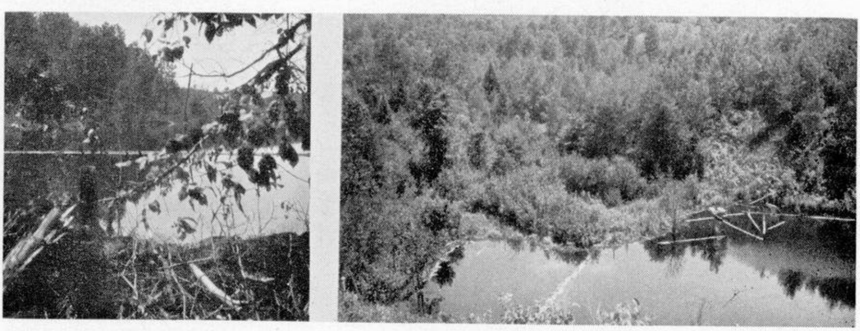


Figure 11. Beaver dam in northwestern Florence County, located between two esker-like ridges. The left-hand picture is a view taken from the lower side of the dam, looking upstream across the pond toward the beaver house, which can be seen in the center of the picture. The right-hand picture is a view of the same pond from an adjacent ridge crest. Beaver dams raise the water table locally and favor the development of bodies of wet soils.

Figure 12. A man operating a bulldozer is an active "factor of soil formation" as he alters the upper part of the soil profile.

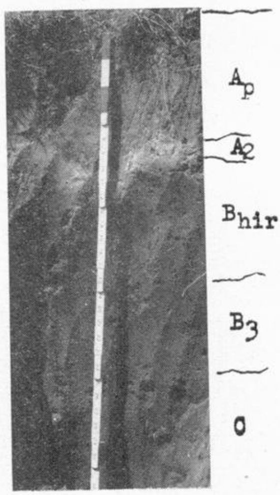


Figure 13. Pence sandy loam (in unit number 10 on the colored soil map), the upper horizon of which has been changed by man. The A_p (0″–10″) is a plowed layer, which rests on a remnant of the original A_2 (10″–12″), under which are the B_{hir} (12″–19″), B_3 (19″–24″) and C (24″–33″) horizons.

tion of the whitish A_2 horizon and can weaken the development of the brown B horizon.

MAN AS A FACTOR OF SOIL FORMATION. Man has changed the soils of Florence County by changing the vegetation, by burning forests and forest residues, by land-smoothing and earth-moving operations (see Figure 12) connected with logging, construction and agriculture, by raising and lowering fertility levels, and by protecting the soils or exposing them to frost, direct sunlight, and to erosion by wind and water. The bits of charcoal which occur in the surface soil over most of Florence County form perhaps the most enduring record in the soil of changes made during the period, 1850–1920. The agricultural activities of man have so disturbed the upper seven inches of soil in cultivated areas that the classification of soils in Figures 28 and 35 emphasizes the B horizon which lies below plow depth. In plowed fields, soils must be classified on the basis of horizons below the plow layer. Figure 13 shows a profile in a plowed Pence sandy loam with an unusually deep-lying remnant of an A_2 horizon. The A_p apparently represents not only a mixture of original organic surficial horizons and upper A_2, but also a soil 9 or 10 inches thick brought in by the plow from small adjacent elevations to fill in a former slight depression in the forest floor. In many parts of such a field, the A_2 is completely destroyed by the plow, and only the B horizon and underlying horizons remain as a basis for classification.

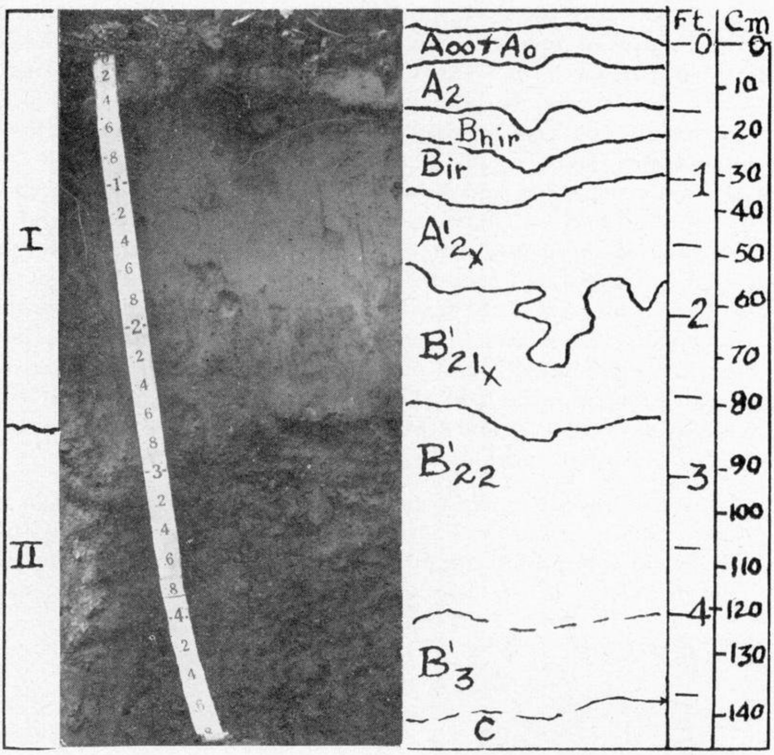


Figure 14. Goodman silt loam, in the N.E.¼ Sec. 27, T.39N., R.16E. This is a bisequum or double profile: a Podzol soil profile 30 centimeters deep over a Gray-Brown Podzolic soil profile. Both are forest soil profiles, and here occur together. The A'_{2x} horizon appears to be invading or "degrading" the B'_{21x} horizon. The Roman numerals on the left indicate two parent materials, a coarse silt loam (I) and a stony, till-like layer (II) over coarse sand and gravel outwash (III, not shown).

The Effects of these Factors on a Typical Well-drained Soil

The effects of the factors of soil formation, discussed above, are most readily seen in well drained soils, the parent material of which contained as much as 15 per cent clay. Figure 14 shows a soil profile of silt loam over gravel with interstitial loam, in which these effects show most clearly. The upper-most foot of soil is a Podzol profile. This is made up of the organic litter and humus layer, a pale A_2 horizon, and a dark brown, soft B_{hir} horizon which is relatively high in contents of organic matter and iron, as compared with horizons immediately above and below. The Podzol soil profile has been formed by downward movement by percolating water of humus (h) and iron (ir), with accumulation of these in the B_{hir} and B_{ir} horizons. Below the shallow Podzol soil are what appear to be major portions of a weakly developed Gray-Brown Podzolic soil profile, consisting of a pale brown horizon (A'_2), referred to as the "fragipan" (Figure 15), and a somewhat more clayey B'_2 horizon. There are clay skins coating peds in the lower part of the B'_2 horizon, including that formed in the loam material lying between the stones. The boundary between the fragipan (A'_{2x}) and the B'_2 and B'_3 (sometimes referred to as the B'_t horizons, meaning textural or clay-enriched B) is irregular. It appears that the A'_{2x} is extending down in the B'_2 in tongues, as if the upper B'_2 were being gradually destroyed and washed downward. Figure 15 is a closeup view of the A'_{2x} horizon, showing both platy structure and vertical prismatic structure of the dense, somewhat brittle horizon. In the early spring of the year, after the soil has thawed, subsurface snow-melt water flows down-slope over the top of the fragipan or A'_{2x} horizon. This soil profile is acid throughout (and is therefore not a Gray Wooded soil, such as occurs in northwestern Minnesota), and exhibits a degraded upper B horizon undergoing invasion from above by the A_{2x}horizon. Several theories (Gardner and Whiteside, 1952; Frei and Cline, 1949) concerning the origin of this "double" or "bisequal" profile are under consideration, as follows:

1. It is possible that under conditions in a forest environment in Florence County, a shallow Podzol soil profile and a deeper Gray-Brown Podzolic soil profile are formed at the same time. Deeply percolating waters in the late spring and early autumn, when subsoil

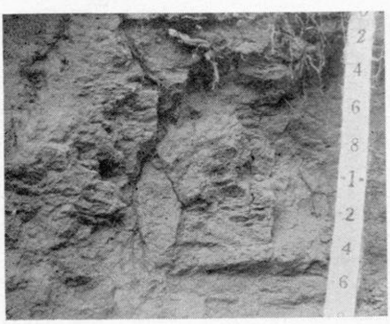


Figure 15. A close-up view of the rough, fractured surface of a fragipan in the Stambaugh silt loam. Two structures are evident: a horizontal platy structure and a vertical columnar structure. Tree roots follow horizontal and vertical cracks. In Figure 14 this is labeled as A'_{2x} horizon and is shown smoothed off by means of a spade.

moisture has been reduced by vegetation and yet precipitation is abundant, move clay down to form the lower textural or clay-enriched B horizon. Shallow-percolating waters form the Podzol profile by concentrating humus and organic matter in the upper B horizon (B_{hir}).

2. It is possible that the Gray-Brown Podzolic soil profile formed first, perhaps during a warmer climatic period about 5,000 years ago. The Podzol may be a young soil formed during the last 2,000 years of cooler climate, developing in the deep A_2 horizon of the old Gray-Brown Podzolic soil. This explanation of the soil shown in Figure 14 does not take account of possible earlier Tundra and Podzol soil profiles, which may have formed under cold climatic conditions in the same place after the glacier had wasted away from Florence County, and before the warmer period began. The deepness of the A'_{2x} horizon (Figure 14), nearly double that of A_2 horizons in modal Gray-Brown Podzolic soils of Indiana and Ohio, is explained as a result of the lower content of clay in the parent material of the Goodman and Stambaugh silty sola.
3. It is possible that this profile exhibits the enduring effect of permafrost (Fitzpatrick, 1956). According to this theory, the soil and glacial and aeolian deposits were frozen to a depth of many feet, after the glacier melted away, some 13,000 years ago. The A'_{2x} horizon, except for the lower tongues, represents the lower active frost zone, that is the zone which froze each winter and melted each summer. This repeated freezing and thawing permitted the soil to settle into a compact mass. Ice lenses created the platy structure in the A'_{2x} and vesicular structure was formed by pressure of air forced out of solution in ground water at times of freezing. The permafrost persisted for centuries, according to this theory, below the central, untongued A'_{2x} and therefore subsurface waters were forced to percolate over frozen subsoil, thereby taking fine clay down slope to depressions. After the disappearance of the permafrost, the entrance of percolating waters into the subsoil washed clay films or coatings into the B'_{2x} horizon, and formed the tongues of the lower A'_{2x} horizon.

   The fact that accumulations of clayey material have not been observed in depressions in Florence County casts doubt on this theory.
4. A related hypothesis is that the A'_{2x} horizon is a gleyed horizon, the locus of bleaching in a zone of seasonal fluctuating water-table. This zone is prominent under cool, temperate, humid climates in imperfectly to well drained soils of glaciated landscape of level to gently rolling topography, in which stream channels are poorly developed. According to this theory, the upper, well-drained portion of a soil profile is a suitable locus for the formation of a Podzol; whereas the lower, imperfectly to moderately well drained portion of the soil profile, where a seasonal, fluctuating water table occurs,

is a suitable locus for the formation of a gley pan and underlying degraded horizon. The term, "Ground-Water Gray-Brown Podzolic" soil (analagous to "Ground-Water Podzol") might describe the condition assumed in this theory.

VI. SOIL DESCRIPTIONS

Introduction

Table XII lists the kinds of soils shown on the colored soil map. Each soil is defined in the following pages by its cross section to a depth of about three feet or so, as shown in Figure 16. This cross section is called the soil profile (Hole & Lee, 1953, 1955), and shows the various soil layers, called soil horizons, in which plant roots develop and feed. A soil body of which the three to four-foot profile is a narrow, representative vertical cross section is a large sheet, irregular in shape, measuring 300 to 3,000 or more feet across. Soil bodies of each kind of soil have a typical range in profile characteristics, slope, susceptibility to erosion under various conditions, native fertility, and response to amendments. It may be said that soil management is simplest on fields or plots which consist of one soil. In such a case, the same treatment can be applied on the entire field with uniform results. However, many soil bodies are irregular ribbons in shape and even a strip in a strip-cropped field may cross two or more bodies of different soils. Where two soils in a field have extremely different management requirements, the operator may handle each portion of the field differently, or may treat the whole field in accordance with the requirements of the least productive part.

Individual soil profile descriptions have been arranged in alphabetical order in the following pages. In most cases exact locations are given for sites at which descriptions were made in the field, although many descriptions have been based on observations made at several sites.

A soil profile description provides important information, because our scientific classification of soils (Kellogg and Cline, 1949; U.S.D.A., 1938; Soil Survey Staff, 1960), as well as our agriculture and silviculture (Wilde, *et al,* 1949), is based on these definite soil units. Great soil groups, such as "Podzol" and "Humic-Gley," are technical terms used by soil scientists in classifying soils throughout the world. They are briefly defined in the footnotes to Table I. As more research is done on the soils, both in the laboratory and in the field, more complete descriptions and data become available. Present data have been compiled by workers of the Wisconsin Geological and Natural History Survey, the College of Agriculture, and by workers of the Soil Conservation Service.

Some technical terms (U.S.D.A., 1938; Soil Survey Staff, 1951) used in the soil description are defined briefly below. Each soil description consists of two parts: a general description and a technical description. The technical portion begins with an introductory paragraph and concludes with a detailed description. The first paragraph gives information about the parent

TABLE XII. DISTRIBUTION OF SOIL SERIES AND WATER, FLORENCE COUNTY, WISCONSIN

Soil Series Name	Symbols of Soils Associations (Map Units) in Which Soil Series Occurs	DISTRIBUTION	
		Percentage[1] of Area of County	Acres
Adolph	15, 16	0.80	2,698
Ahmeek	3	0.60	1,940
Alluvial soils, undifferentiated	15, 16	0.20	452
Auburndale	1	0.30	912
Au Train	12	0.10	286
Bergland	15	0.10	387
Bohemian	14	0.10	115
Brimley	14, 15	0.20	502
Bruce	15, 16	0.20	436
Brule	15	0.10	387
Cable	15, 16	0.80	2,698
Crivitz	5, 9, 10, 11, 12	1.80	5,511
Edwards	15	0.10	387
Emmert	13	0.80	2,691
Fence	6, 14	3.10	10,638
Gaastra	1	0.10	457
Goodman	1, 2, 4, 5	12.50	39,508
"Granitic" rock outcrop	17	0.20	611
Greenwood	16	1.00	3,413
Hiawatha	4, 5, 11, 12	0.40	551
Hibbing	4, 5	1.20	4,100
Iron River	1, 2, 3, 4, 6, 9, 13, 17	4.51	15,345
Linwood	15	0.70	2,324
Manistee	5	0.30	954
Menominee	5	0.10	180
Moye	12, 16	0.20	660
Omega	10	0.70	2,172
Ontonagon	5, 17	0.11	336
Padus	2, 3, 4, 6, 7, 8, 9, 10, 13	5.90	18,541
Pence	2, 3, 4, 6, 7, 8, 9, 10, 12, 13, 17	17.13	54,471
Pickford	15	0.10	387
Randville	4, 12, 14	0.50	1,033
Roscommon	15	0.40	1,162
Rudyard	5	0.10	180
Saugatuck	15	0.10	387
Spalding	15, 17	8.81	27,178
Stambaugh	1, 2, 6, 7, 8, 9, 13, 14, 17	20.01	63,624
Superior	5	0.10	360
Tipler	14	0.10	286
Tromald	15	0.10	387
Ubly (variant)	5, 10	0.70	2,860
Vilas	4, 5, 6, 9, 10, 11, 12, 13, 17	10.13	32,354
Wakefield	2, 3, 4, 5	1.90	5,869
Zim	5	0.10	180
(WATER)	Throughout	2.60	8,270
		100.00	318,080

[1]Percentages are based on weights of various parts of a soil map, as determined with an analytical balance.

material from which the soil formed, the thickness and approximate clay content of the subsoil (B horizon) and of the overlying and underlying horizons, the common types and phases mapped, and names of associated soils. The silt from which the silty soils formed was deposited in post-glacial times, was probably of local origin, and was very likely acid from the beginning. The description of soil horizons gives moist colors and corresponding scientific Munsell notations, such as black (10YR 2/1), taken from the color chart book (Pendleton and Nickerson, 1951) used by soil surveyors; texture (loamy sand, sandy loam, loam, silt loam and so on); structure (granular, platy, blocky); degree of acidity (pH); and sometimes organic matter content. The type location, date, and place of establishment of series are given. Several soil series are at present considered as tentative (see Table I). All depth measurments given in the description are made from the surface of the mineral soil. Therefore the depth of a 5-inch layer of humus is reported as A_0, 5″–0″, but the underlying sandy layer is reported as A_2, 0″–10″. A whitish A_2 horizon is called a "Bleicherde," meaning bleached earth. A soft coffee-brown B horizon is called an "Orterde," meaning soil formed in place. A hard brown B horizon is called "Ortstein," meaning stone formed in place. The symbol "ir" refers to "free iron" or iron oxide. The symbol "h" refers to humus organic matter. The letter "x" stands for a fragile or brittle horizon called the fragipan. The Roman numeral II indicates that the soil horizon in question is developed in a second (lower) parent material, as does the letter "D."

Individual Soil Profile Descriptions

ADOLPH SERIES (Nos. 15 and 16 on the soil map)

General Description. The Adolph series includes wet, medium-textured, moderately deep acid soils of depressions and marsh borders.

Detailed Description. The Adolph series includes naturally wet soils formed from a silty deposit 24″–42″ thick over acid glacial till of sandy loam to loam texture. Natural drainage and aeration conditions have been very poor and the natural vegetation includes tagalder, willow, and sedges. These soils are classified in the Humic-Gley great soil group. The mottled subsoil (Cg horizon) begins at a depth of about a foot and continues downward about 20″, with a maximum clay content of about 15 to 20%

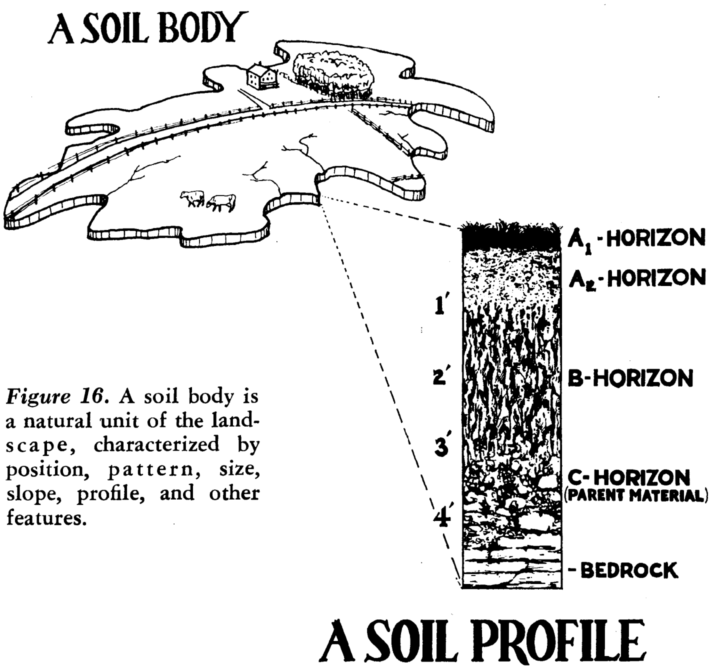


Figure 16. A soil body is a natural unit of the landscape, characterized by position, pattern, size, slope, profile, and other features.

and organic matter content of 0.2 to 0.5%. Above the subsoil are silty layers (A horizon (8″ to 12″ thick, containing 15 to 40% clay, 50 to 70% silt, 15 to 20% organic matter. Slope gradients are usually less than 2%. Associated soils are peat, Cable, and Spirit. Some bodies of Adolph are stony. The Podzol B horizon is so widespread in mineral soils in Florence County that areas of Humic-Gley soils are inextensive. This soil was observed in the N.W.¼N.E.¼ Sec. 29, T. 39 N., R. 16 E. A profile description follows:

4″–3″ (10–8 cm)	A_{00}	Leaf litter.
3″–0″ (8–0 cm)	A_0	Peat layer.
0″–5″ (0–13 cm)	A_{11}	Black (10YR 2/0) silt loam; moderate, medium granular to subangular blocky structure; friable to firm; pH 5.5; about 18% organic matter; clear, wavy boundary.
5″–12″ (13–31 cm)	A_{12}	Black (10YR 2/1) silt loam with dark reddish-brown (5YR 3/4) mottles; moderate, medium to fine subangular blocky structure; friable to firm; pH 5.5; about 2% organic matter; clear, wavy boundary.
12″–30″ (31–76 cm)	C_g	Gray to olive-gray (10YR 6/1–5Y 5/2) silt loam to silty clay loam; massive to weak, fine angular blocky structure; friable to firm; pH 5.3; about 0.2% organic matter; clear, wavy boundary.
30″–40″ (76–102 cm)	D_g	Gray (10YR 5/1) to reddish-gray (5YR 5/2) stony loam, mottled yellowish-brown and strong brown (10YR 5/8; 7.5YR 5/6) massive to weak, coarse platy and subangular blocky structure; pH 5.5; about 0.14% organic matter.

Type location: S.W.¼ S.W.¼ Sec 21, T.38N., R.26W., Mille Lacs County, Minnesota. Series established: In 1927, Mille Lacs County, Minnesota. Source of name: Village in St. Louis County, Minnesota.

AHMEEK SERIES (No. 3 on the soil map)

General Description. The Ahmeek series includes well drained, medium-textured acid soils shallow to bedrock or stony till.

Detailed Description. This series includes well to moderately well drained soils developed from acid reddish-brown loam to clay loam glacial till or from less than 18″ of silty material over shallow till (about 4′ thick), which contains numerous stones from bedrock "iron formation" (Figure 8 and Table VII). Bedrock outcrops are associated. The original vegetation was mixed coniferous and deciduous forest, but present new growth is maple and basswood forest. These soils have been classified as Acid Brown Forest (Sols Bruns Acides), but in Florence County the presence of the color of a Podzol B beneath the A_1 horizon, and the local occurrence of Podzols in a micro-complex with the Ahmeek soils indicates that Ahmeek soils are Brown Podzolic soils. The subsoil (B_{ir}) begins at a depth of about 7″ and continues downward for about 13″ through a weakly to strongly developed fragipan (B_x), which begins at a depth of about 14″. Silt loams have about 15% to 20% clay and 55% silt, but loams contain about 10% clay and 35% silt. The content of organic matter is about 1% and base saturation 30%. Above the subsoil is a dark silt loam or loam horizon (A_1) with the same content of clay and silt as the B_{ir} horizon, but with about 6% organic matter. Slope gradients range from 0% to 15%. Cradle-knolls, which are mounds and hollows caused by tree-throw, may be closely spaced. The fragipan may be quite hard, breaking out under the pick somewhat like slabs of slag from a furnace. Soil types are silt loam, loam, fine sandy loam. In Florence County there are some Ahmeek-like soils developed from 18″ to 30″ of silty material over till. Associated with Ahmeek soils are Hibbing, Goodman, and Iron River series. Ahmeek soil profiles in Florence County have been described in the S.W.¼S.W.¼ Sec. 34 and N.W.¼S.W.¼ Sec. 24, T.40N., R.18E. and in the N.W.¼N.W.¼ Sec. 35, T.40N., R.17E. See Table XVII for additional data. A profile description follows:

½″–0″ (1.3–0 cm)	A_{oo}	Leaf litter.
0″–2″ (0–5 cm)	A_{11}	Black (10YR–5YR 2/1–2/2) silt loam, with 5% stones by volume; moderate, medium granular structure; friable; pH 5.5; about 18% clay, 55% silt and 6% organic matter; clear, wavy boundary.
2″–5″ (5–13 cm)	A_{12}	Very dark gray (5YR 3/1) to dark reddish-brown (5YR 3/2–3/1) silt loam, with 5% stones by volume; moderate, coarse granular to fine subangular blocky structure; pH 5.5; about the same content of clay and silt as above; about 4% organic matter.
5″–7″ (13–18 cm)	A–B	Mixed dark reddish-brown (5YR 3/3) and reddish-brown (4/3) silt loam; moderate, fine subangular blocky structure; friable; pH 5.7; clear, wavy boundary.
7″–13″ (18–33 cm)	B_{ir}	Dark reddish-brown (5YR 3/3) silt loam grading to loam below; weak to moderate, medium angular blocky structure; friable; pH 5.7; about 0.7% organic matter; stone, clay and silt content as in the A; clear, wavy boundary.
13″–26″ (33–66 cm)	B_x	Dark reddish-brown (5YR 3/4) loam with coatings of dark reddish-gray (5–7.5YR 4/2) on coarse plates and fine subangular blocks; compact and firm in place but crushes suddenly under pressure; pH 5.4 above to 5.9 below; about 0.4% organic matter; about 10% clay and 30% silt; 18% stone by volume; massive and moderately cemented until disturbed; digs out with unusual difficulty; vesicular; pebbles may be coated on upper surfaces with somewhat cemented gray loam, but are not coated on the under surfaces; in the spring, water moves over the surface of this horizon and enters a freshly dug pit from the B_{ir} horizon; clear, wavy boundary.
26″–36″ (66–92 cm)	C	Reddish-brown (2.5YR 4/4) loam to clay loam; 25% stones by volume; massive with some weak, medium blocky structure; friable; pH 5.9; about 0.1% organic matter; about 22% clay, 40% silt.

Type location: Lake County, Minnesota. Series established: Houghton County, Michigan. Source of name: Town in Keweenaw County, Michigan.

ALLUVIAL SOILS, UNDIFFERENTIATED (Nos. 15 and 16 on the soil map)

Alluvial soils other than the Brule series have not been classified in this survey into series. They are of limited extent. They are grouped with organic soils and other wet soils on the soil map. They are for the most part imperfectly to very poorly drained, and occur in association with organic soils along rivers and streams.

Well to moderately well drained alluvial soils do occur locally, as at the head of LeRoy Creek in Section 6, T.40N., R.16E., where an alluvial fan deposit lies to the north of a bog, and a small, nearly level alluvial plain (see Figure 17) lies to the west of the bog. In the southwestern portion of this flat area in the N.W.¼S.W.¼ Sec. 6, T.40N., R.16E. is a loam soil with a very dark brown 10″ (25 cm) cobbly loam A_1 horizon with about 3% organic matter and pH of 6.7. Immediately below A_1 a calcareous brown to dark brown loamy sand extends to a depth of at least 8′

(244 cm). Local alluvial overwash from farmers' fields and road ways occurs in depressions in the county.

AUBURNDALE SERIES (No. 1 on the soil map)

General Description. The Auburndale series includes somewhat wet, medium-textured, moderately deep acid soils of depressions and marsh borders.

Detailed Description. This series includes naturally wet soils formed from 30″ to 50″ of silty deposit over acid loam glacial till. Original vegetation was willow, tagalder, tamarack, balsam fir, black spruce, red maple, sedges. These soils are classified as Low Humic-Gley soils which "plow up white," in contrast with the Humic-Gley soils which "plow up black" because of the greater depth of the A_1 horizon. The subsoil (Bg or Cg) begins at a depth of about 10″ with contents of about 22% clay and 55% silt. Above the subsoil is a silt loam dark horizon (A_1) with about 15% organic matter and about 18% clay and 55% silt. Slope gradients are less than 2%. Associated soils are Cable, Spirit, Goodman, Wakefield, Iron River, peat, Stambaugh. This soil was observed in the N.W.¼ Sec. 32, T.40N., R.15E. A profile description follows:

1½″–½″ (4–1.3 cm)	A_{00}	Leaf litter.
½″–0″ (1.3–0 cm)	A_0	Nearly black humus layer.
0″–5″ (0–13 cm)	A_1	Very dark gray (5YR 3/1) above, to grayish-brown (2.5Y 5.2) below, silt loam; moderate medium to fine granular to weak fine blocky; friable; pH 5.0; clear, wavy boundary.
5″–12″ (13–18 cm)	A_{2g}–B_{1g}	Grayish-brown (2.5Y 5/2) mottled light olive brown (2.5Y 5/4) silt loam; weak fine platy to subangular blocky; friable; pH 5.3; clear, wavy boundary.
12″–42″ (31–107 cm)	C_g	Gray (5Y 6/1) silt loam, mottled with dark brown (7.5YR 4/4); weak fine platy and vesicular above to fine subangular blocky below; friable; pH 5.5; clear, wavy, boundary.
42″–50″ (107–127 cm)	D_g	Olive gray (5Y 5/2) mottled brown (7.5YR 5/5) loam; massive; friable; pH 5.5.

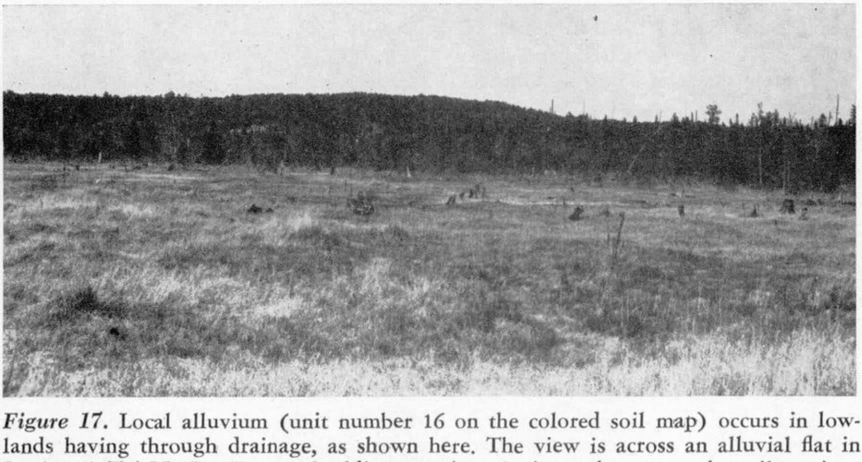


Figure 17. Local alluvium (unit number 16 on the colored soil map) occurs in lowlands having through drainage, as shown here. The view is across an alluvial flat in Section 6, T.40N., R.16E. to a Spalding peat bog (unit number 15 on the soil map) to forested hills of Goodman and associated soils (unit number 2).

Type location: N.E.¼ Sec. 27, T.32N., R.9E., Langlade County, Wisconsin. Series established: Langlade County, Wisconsin 1947. Source of Name: Village in Wood County, Wisconsin.

AU TRAIN SERIES (No. 12 on the soil map)

General Description. The Au Train series includes rather droughty, acid sands having a cemented subsoil layer ("hardpan"), and usually found on low-lying benches near peat bogs.

Detailed Description. This series includes soils developed from acid glacio-fluvial sands. Natural drainage or aeration is good to excessive. The original vegetation included white and red pine, hemlock, and hardwoods. These soils are classified as maximal Podzols. The subsoil (B_{irh}) is about 17″ thick and begins at a depth of about 10″, with maximum contents of about 12% clay, 10% silt, 2% organic matter (h), 2% reductant-soluble iron (ir); 50 lbs. per acre of available potassium; base exchange capacity of 12 m.e./100 g. and 27% base saturation. The available phosphorus content ranges from about 1 lb. per acre in the upper part of this horizon to 38 lbs. in the lower part. Bulk density ranges from 1.2 in the upper B_{hir} to 1.6 in the orstein. This horizon is variable in thickness and exhibits tongues which extend as much as three feet into the substratum. Below the brown B_{hir} is a pale, incipient fragipan (B_3 or A'_{2x} and B'_x) about 18″ thick. It is as dense as the ortstein, contains about 5% clay and the same amount of silt and 0.3% organic matter. Above the subsoil is a paler sand horizon (A_2 horizon) containing about 5% clay and 10% silt, 0.3% reductant-soluble iron, and organic matter ranging in content from 3% above to 0.5% below. There are about one lb. of available phosphorus and 25 lbs. of available potassium per acre in this horizon, which has a cation exchange capacity of about 5 m.e./100 g. and a base saturation of 25%. Bulk density ranges from 0.9 above to 1.3 below. The A_2 horizon thins and thickens irregularly, with tongues projecting downward just over the tongues of the B_{hir}. Slope gradients are usually less than 2%. Soil types are sand and loamy sand. Associated soils include Hiawatha, and Vilas. See Table XV for more information. Excellent profiles were examined in the N.W. corner of Sec. 17, T.38N., R.19E. Cradle knolls (tree-tip mounds and hollows) were rather numerous near this site. A profile description follows:

2″–¼″ (5–.7 cm)	A_{00}	Leaf litter and a fermenting layer below it.
¼″–0″ (.7–0 cm)	A_0	Black peaty humus containing some small charcoal fragments and an abundance of tree roots.
0″–½″ (0–1.3 cm)	A_1	Black (5YR 2/1) loamy sand containing light gray (7/1)) quartz grains; weak, medium granular to single grain; very friable; pH 4.5; about 15% organic matter. Abrupt, irregular boundary.
½″–1″ (1.3–2.5 cm)	A_{21}	Dark gray (5YR 4/1) loamy medium sand; very weak, medium granular to single grain; loose; contains some charcoal; about 3% organic matter; pH 4.1; gradual, irregular boundary.
1″–8″ (2.5–20 cm)	A_{22}	Reddish-gray (5YR 5/2) medium sand; single grain; loose; pH 5.2; 0.5% organic matter; 0.2% reductant-soluble iron; clear, irregular boundary.
8″–9″ (20–23 cm)	A_{23}	Dark reddish-gray (5YR 4/2–5/2) medium sand; single grain; loose; pH 5.1; 0.7% organic matter; abrupt, irregular boundary.
9″–12″ (23–31 cm)	B_{hir1}	Very dusky red (2.5YR 2/2–3/2) loamy medium sand; massive to weak, angular blocky; soft and very friable; pH 5.3; 2.1% organic matter; 1.8% reductant-soluble iron; roots still abundant; abrupt, irregular boundary.

12″–21″ (31–53 cm)	B_{hir2}	Dark reddish-brown (2.5YR 2/4) loamy medium sand; massive; cemented; crushes with difficulty to irregular fragments; pH 5.5; 1.6% organic matter; 1.2% reductant-soluble iron; roots only along faces of fractures in this ortstein; clear, irregular boundary.
21″–25″ (53–64 cm)	B_{hir3}	Red (2.5YR–5YR 4/8) loamy medium sand; massive; soft and loose, to slightly cemented; pH 5.4; 0.7% organic matter and the same content of reductant-soluble iron; very few roots; clear, irregular boundary.
25″–46″ (64–117 cm)	B_3 (or $A'2x$, B'_x)	Incipient fragipan; reddish-brown (5YR 4/3) with some bands of reddish-gray and reddish-brown (5YR 4/2 and 4/4); massive, slightly cemented; shatters under pressure between the fingers; very few roots; pH 5.6; about 0.3% organic matter and the same content of reductant-soluble iron; gradual, irregular boundary.
46″–86″ (117–219 cm)	C	Brown (7.5YR 5/4) medium sand; single grain; loose to slightly cemented; 3% clay and 3% silt; pH 5.2.

Type location: Ontonagon County, Michigan. Series established: 1939, Alger County, Michigan. Source of name: Village in Alger County, Michigan.

BERGLAND SERIES (Nos. 15 and 16 on the soil map)

General Description. The Bergland series includes wet, deep clay soils which are limey at depths of 24″ to 30″.

Detailed Description. The Bergland series includes soils developed from reddish-brown dolomitic or calcareous silty clay or clay of lacustrine or glacio-lacustrine origin, under poor natural drainage and aeration conditions. Natural vegetation includes spruce, cedar, balsam fir, hemlock, elm, ash, birch, aspen, and hard maple. These soils are classified as Humic-Gley soils. The subsoil (C_g) begins at a depth of about 8″ and continues downward about 2′, with contents of about 55% clay and 45% silt, 0.5% organic matter. Above the subsoil is a silty clay loam horizon (A_1) containing about 40% clay, 60% silt, besides 15% organic matter. Slope gradients are less than 2%. Associated soils are the Pickford, Rudyard, Ontonagon, and Superior soils. This soil was observed in the N.E.¼S.W.¼ Sec. 2, T.38N., R.18E. A profile description follows:

5″–4″ (13–10 cm)	A_{oo}	Leaf litter.
4″–0″ (10–0 cm)	A_o	Peaty black humus.
0″–8″ (0–20 cm)	A_1	Black (10YR 2/1) silty clay loam; weak to moderate granular to fine, subangular blocky structure; firm; pH 4.8; abrupt, smooth boundary.
8″–29″ (20–74 cm)	C_{g1}	Reddish-brown (2.5YR 4/4) mottled gray, brown and pale red (10YR 5/1; 7.5YR 4/4; 2.5YR 6/2); silty clay; moderate medium to coarse angular blocky structure; very firm; pH 5.0 above to 7.0 below; clear, wavy boundary.
29″–36″ (74–92 cm)	C_{g2}	Reddish-brown (2.5YR 4/4) mottled with gray (10YR 5/1), silty clay or clay; weak, coarse angular blocky; very firm; dolomitic or calcareous.

Type location: Ontonagon County, Michigan. Series established: Ontonagon County, Michigan, 1921. Source of name: Ontonagon County, Michigan.

BOHEMIAN SERIES (No. 14 on the soil map)

General Description. The Bohemian series includes deep, well-drained soils of medium texture, which are limey at depths of 3 to 8′.

Detailed Description. The Bohemian series includes well-drained soils developed from less than 18″ of silty material over pale reddish-brown stratified silts, very fine sands and clays which are calcareous at 30″ to 100″. Original vegetation included northern hardwoods and white and red pine. These soils are classified as minimal to medial Podzols with a lower Gray Wooded profile. The subsoil (B_{hir}) begins at a depth of about 8″, and continues downward about a foot and is underlain by a pale loam horizon 3″ or 4″ thick, and then continues another 10″ as a reddish-brown horizon (B_t). The maximum clay content in the upper subsoil (B_{hir}) is about 20% and in the lower subsoil (B_t) is about 35%. Above the subsoil is a pale silt loam horizon (A_2) about 7 inches thick containing about 15% clay and 65% silt and 1.5% organic matter. Slope gradients are from 2% to 15%. Associated soils are the Brimley, Bruce, and Ontonagon. Soil types are silt loam, loam, fine sandy loam. This soil was observed in the S.W.¼ Sec. 11, T.38N., R.18E. A profile description follows:

1″–½″ (2.5–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Very dark gray peaty humus.
0″–1″ (0–2.5 cm)	A_1	Very dark gray (5YR 3/1) silt loam; weak, fine granular; very friable; pH 4.5; abrupt, smooth boundary.
1″–7″ (2.5–18 cm)	A_2	Brown (7.5YR 5/2) silt loam; weak, medium to coarse platy structure; friable; soft; pH 4.3; clear wavy boundary.
7″–10″ (18–25 cm)	B_{hir1}	Reddish-brown (5YR 4/4) silt loam; weak medium subangular blocky to granular; friable; pH 4.2; clear, wavy boundary.
10″–18″ (25–46 cm)	B_{hir2}	Yellowish-red (5YR 4/6) silt to silt loam; weak, medium platy to subangular blocky; friable; pH 5.0; clear, wavy boundary.
18″–22″ (46–56 cm)	A'_2	Brown (7.5YR 4/4) silt loam; weak, medium subangular blocky; friable; soft; pH 5.5; diffuse, wavy, boundary.
22″–30″ (56–76 cm)	B'_t	Reddish-brown (5–2.5YR 4/4) silt loam to coarse silty clay loam; moderate, medium subangular blocky; plastic; pH 5.8; clear smooth boundary.
30″–90″ (76–229 cm)	C_1	Reddish-brown (2.5YR 4/4) stratified silts, very fine sands and thin layers of clay; massive; friable.
90″–100″ (229–254 cm)	C_2	Similar material, but dolomitic at 100″.

Type location: S.W.¼N.W.¼ Sec. 26, T.51N., R.34W., Baraga County, Michigan. Series established: Chippewa County, Michigan, 1927. Source of name: Township in Ontonagon County, Michigan.

BRIMLEY (Nos. 14, 15 and 16 on the soil map)

General Description. The Brimely series includes deep, naturally imperfectly drained soils of medium texture which are limey at depths of 3′ to 5′.

Detailed Description. This series includes soils formed under naturally imperfect conditions of drainage and aeration from less than 18″ of silts over stratified silts, fine sands and clays which are calcareous or dolomitic at depths of 30″ to 60″. The original vegetation included northern hardwoods, balsam fir, and white cedar. These soils are classified as imperfectly drained Podzols, having a lower Gray Wooded profile. The subsoil (B_{hirg}) begins at a depth of about 10″ and continues downward about a foot, with contents of about 10% clay, 50% silt, and 2% organic matter. Below this there may be a second, pale horizon (A'_2) over the lower brown subsoil horizon (B'_{tg}), containing about 28% clay and 40% silt, and having a thickness of about 8″. Above the subsoil is a pale silt loam horizon (A_2) containing about 15% clay, 60% silt, and 1.5% organic matter. Slope gradients are less than 2%. Soil types are silt loam and loam. Associated soils are Bruce, Bohemian, Rudyard, Ontonagon. This soil was observed in the S.W.¼ Sec. 25, T.38N., R.18E. A profile description follows:

1″–½″ (2.5–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Peaty humus.
0″–½″ (0–1.3 cm)	A_1	Very dark gray (10YR 3/1) silt loam; weak, very fine granular; friable; pH 5.5; clear, irregular boundary.
½″–10″ (1.3–25 cm)	A_{2g}	Light brownish-gray (10–7.5YR 6/2) silt loam mottled with brown (10YR 5/2); moderate medium granular; friable; soft; pH 5.5; clear, wavy, boundary.
10″–20″ (25–52 cm)	B_{hirg}	Brown (7.5YR 4/4) mottled dark brown, strong brown, and pinkish gray (7.5YR 4/2, 5/6, 6/2) silt loam; weak, medium, subangular blocky to moderate, medium platy; firm, then friable under pressure; clear, wavy boundary.
20″–30″ (52–76 cm)	B'_{tg}	Brown (7.5YR 4/4) mottled strong brown (7.5YR 5/6) sandy clay loam to silty clay loam; moderate, medium subangular blocky; firm; pH 6.0; clear, wavy boundary.
30″–40″ (76–102 cm)	C_{1g}	Yellowish-brown (10–7.5YR 5/4) mottled strong brown (7.5YR 5/6) silt and very fine sand, stratified; massive to single grain; locally somewhat coherent; pH 6.8 (dolomitic at 36 to 50 inches).

Type location: W. Center S.W.¼ Sec. 2, T.46N., R.1E., Chippewa County, Michigan Series established: Chippewa County, Michigan, 1927. Source of name: Town in Chippewa County, Michigan.

BRUCE SERIES (Nos. 15 and 16 on the soil map)

General Description. The Bruce series includes wet, deep medium-textured low-lying soils which are limey at depths of 2′ to 8′.

Detailed Description. This series includes soils formed under naturally very poor conditions of drainage and aeration from less than 2′ of silts over stratified silts, fine sands and clays, which are calcareous or dolomitic at 2′ to 8′. The original vegetation included mixed hardwoods, cedar, and balsam fir. These soils are classified as Humic-Gley soils. The subsoil (C_g) begins at a depth of about 8″ and continues downward about 16″, with maximum contents of 30% clay, 60% silt, and 0.2% organic matter. Above the subsoil is a dark silt loam horizon (A_1) with about 25% clay, 60% silt, besides 15% organic matter. Slope gradients are under 2%. Associated soils are Brimley, Bohemian, Rudyard, Ontonagon. This soil was observed in the S.W.¼S.E.¼ Sec. 24, T.38N., R.18E. A profile description follows:

4″–3″ (10–8 cm)	A_{oo}	Leaf litter.
3″–0″ (8–0 cm)	A_o	Black, mucky peat.

0″–8″ (0–20 cm)	A_1	Black (10YR 2/1) silt loam; moderate medium granular structure; friable; pH 6.5; abrupt, wavy boundary.
8″–20″ (20–51 cm)	C_{1g}	Grayish-brown (2.5Y 5/2) silt loam to clay loam; mottled with dark yellowish-brown (10YR 4/4); moderate, medium subangular blocky; plastic; pH 7.0; gradual, wavy boundary.
20″–40″ (51–102 cm)	C_{2g}	Grayish-brown (2.5Y 5/2) stratified silt and very fine sand with seams of clay and sandy loam; massive to weak, medium platy; friable to loose; calcareous at 24 to 40 inches.

Type location: S.E. 10 acres of S.W.¼S.W.¼ Sec. 2, T.46N., R.1E., Chippewa County, Michigan. Series established: Chippewa County, Michigan. 1927. Source of name: Township in Chippewa County, Michigan.

BRULE SERIES (Nos. 15 and 16 on the soil map)

General Description. The Brule series includes well drained, slightly acid alluvial soils of medium texture.

Detailed Description. This series includes well to moderately well drained Alluvial soils of bottomlands developed from medium to slightly acid coarse to medium textured brown to reddish-brown materials. This appears to be the most extensive Alluvial soil in the county. Original vegetation was alder, balsam fir, red maple, ash, elm, spruce, cedar, some reeds, and sedges. The dark surface soil, relatively high in content of organic matter, is underlain immediately by parent material. There are buried organic-rich horizons in some profiles. Locally the soil is quite red (10R 2/1 above to 2.5YR 3/2 below). Slope gradients are less than 2%. See Table XVII for additional information. This soil was observed in the S.E.¼N.E.¼ Sec. 8, T.40N., R.18E. A profile description follows, taken about 100 feet or 32 meters from the Brule River.

0″–9″ (0–23 cm)	A_{11}	Dark reddish-brown (5YR 3/2) silt loam; well-developed fine subangular blocky; friable; abrupt, clear boundary; pH 7.0.
9″–11″ (23–28 cm)	C_1	Brown (7.5YR 5/2–5/4) fine sandy loam with A_1 earth worm-moved material; friable; massive; abrupt, smooth boundary; pH 7.0.
11″–20″ (28–51 cm)	C_2	Dark brown (7.5YR 3/2–2/2) very fine sandy loam, with streaks of brown (7.5YR 5/3); massive; friable; abrupt, smooth boundary; pH 7.0.
20″–24″ (51–61 cm)	C_3	Dark brown (10YR 4/3 and 3/2) coarse sandy loam; massive; loose; abrupt, smooth boundary; pH 7.0.
24″–25″ (61–64 cm)	C_4	Black (10YR 2/1) loamy medium sand; massive; slightly cemented; pH 7.0.
26″–30″ (63–76 cm)	C_5	Yellowish-red and dark gray (5YR 4/6 and 10YR 4/1, 4/2, and 2/2) loose medium and coarse loamy sand to sandy loam.
30″–36″ (76–92 cm)	C_6	Fine gravel and coarse sand; fairly dark and poorly sorted.

Type location: Iron County, Michigan. Series established: Iron County Michigan, 1930. Source of name: The Brule River.

Figure 18. This is Cable silt loam, a low-lying, poorly drained soil found at the borders of peat bogs on glacial moraines. Under the thin mat of grass and sedge litter are six inches of black silt loam (A_1) underlain by a thin, rusty-spotted, dark gray sandy loam layer (A_{2g}) under which are mottled, fine sandy loam (C_{1g}) and heavy sandy loam (C_{2g}) horizons formed in acid glacial till. This is classified as a Low Humic-Gley soil and is included in unit number 16 on the soil map.

CABLE SERIES (Nos. 15 and 16 on the soil map)

General Description. The Cable series includes wet, shallow, acid soils of medium texture in depressions and along the borders of marshes and bogs.

Detailed Description. This series includes naturally wet soils developed from 12″ to 24″ of silty deposits overlying acid sandy loam to loam till in depressions. Original vegetation included tagalder, willow, balsam fir, tamarack, black spruce, red maple, sedges. These soils are classified as Low Humic-Gley soils which "plow up white," in contrast to the Humic-Gley soils which "plow up black" because of the great depth of the A_1 horizon. The subsoil (C_g) begins at a depth of about 9″ and has contents of about 18% clay and 55% silt. Above the C is a dark silt loam layer (A_1 horizon) with about 15% organic matter and about the same contents of clay and silt as in the C horizon. Slope gradients are less than 2%. Associated soils are Goodman, Spirit, Auburndale, Wakefield, Iron River, Ahmeek, peat. See Table XVII for more information. In north-western Florence County the pH of the underlying glacial till may rise with depth to 8.0. The Cable soil was observed in the S.E.¼ of Sec. 29, T.40N., R.17E. A profile description follows:

3″–0″ (7.7–0 cm)	A_o	Black (10YR 2/1) mucky decaying organic matter; weak, fine granular structure; twigs and many fine roots; abrupt, smooth boundary; pH 5.3.
0″–3″ (0–7.7 cm)	A_1	Dark gray (10YR 4/1) silt loam massive to weak subangular fine blocky; slightly plastic; clear, wavy boundary; pH 5.7.
3″–9″ (7.7–23 cm)	$G–A_1$	Light brownish-gray (10YR 6/2) with a few, fine, faint mottles of pale yellow (2.5Y 7/4) coarse silt loam; massive and firm when dry; plastic, but not sticky when wet; abrupt, wavy boundary; pH 6.3.
9″–24″ (23–61 cm)	C_g	Light brownish-gray (10YR 6/2) heavy silt loam, with many, medium, distinct brown to dark brown (7.5YR 4/4) and yellowish-red (5YR 5/6) mottles; massive; plastic and slightly sticky; water entered the pit at 24″ on Aug. 30, 1961; abrupt, smooth boundary; pH 5.5.
24″–48″ (61–122 cm)	D	Reddish-brown to dark brown (5–7.5YR 4/4) heavy loam till; wet and sticky; massive to weak, coarse platy; pH 5.5.

Type location: N.E.¼ Sec. 24, T.35N., R.11E., Oneida County, Wis. Series proposed: Clark County, Wisconsin, 1942. Series is tentative. Source of name; Village in Bayfield County, Wisconsin.

CRIVITZ SERIES (Nos. 5, 9, 10, 11, 12 on the soil map)

General Description. The Crivitz series includes deep, droughty, acid loamy sands of glacial uplands.

Detailed Description. This series includes fine sands and loamy fine sands and light sandy loams formed under good to excessive natural drainage and aeration conditions, from acid glacio-fluvial deposits. The parent material appears to have consisted originally of 15″ to 30″ of loamy fine sand overlying sand containing some gravel. The original vegetation included jack pine and northern hardwoods. These soils are classified as minimal or weak Podzols. The subsoil (B_{hir}) begins at a depth of about 4″ and continues downward nearly 2′ with maximum contents of about 7% clay, 10% silt, and 1.2% organic matter. The B horizon exhibits coherence, particularly in the lower part. Above the B horizon is a thin loamy sand (A_2 horizon) containing about the same amounts of clay and silt but about half as much organic matter as the B. In a few places, very fine sandy loam layers occur below the B horizon in Florence county. Slope gradients are usually less than 10%. See Table XVII for additional information. Associated soils are Vilas, Hiawatha, Omega, Pence. This soil was observed in the S.E.¼, Sec. 16, T.38N., R.18E. A profile description follows:

1″–½″ (2–1.3 cm)	A_{oo}	Predominantly light yellowish-brown (10YR 6/4) maple leaf litter and brown (7.5YR 5/4) needle litter. Abrupt lower boundary.
½″–0″ (1.3–0 cm)	A_o	Dark brown (7.5YR 4/2) decomposing leaf and needle litter. Abrupt lower boundary.
0″–2½″ (0–6.4 cm)	A_1	Very dark brown (10YR 2/2) loamy fine sand to sandy loam; medium weak crumb to granular structure; friable consistence; abrupt lower horizon boundary; pH 4.8. Considerable mixing into the A_2. Many fine roots and much organic matter mask the structure.
2½″–4½″ (6.4–11.5 cm)	A_2	Gray (10YR 5/1) to brown (7.5YR 5/2) loamy fine sand; coarse very weak subangular blocky; very friable; abrupt; pH 5.3.
4½″–13″ (11.5–33 cm)	B_{hir}	Yellowish-red (5YR 4/6) loamy fine sand; coarse and medium weak to moderate angular blocky; weakly friable; clear; pH 5.7.
13″–22″ (33–56 cm)	B_{ir}	Reddish-yellow (7.5YR 6/6) loamy fine sand; coarse and medium weak angular blocky; very friable; clear; pH 6.0.
22″–45″ (56–114 cm)	C	Light reddish-brown (5YR 6/4) fine sand; single grain to very coarse and coarse weak angular blocky; loose to weakly friable; pH 6.0. Some gravel present.

Type location: West ¼ corner, Sec. 21, T.32N., R.20E., Marinette County, Wisconsin. Series proposed: Marinette County, Wisconsin, 1955. Series tentative. Source of name: Small village in Marinette County, Wisconsin.

EDWARDS MUCK (No. 15 on the soil map)

General Description. The Edwards series includes naturally very wet, shallow to moderately deep muck soils overlying marl (bog lime).

Detailed Description. This series includes soils formed from 12″ to 42″ of muck over marl. It is presumed that the marl was deposited on a lake bottom, and that bog vegetation encroached over the marl and furnished the accumulation of organic matter to form the muck. The forest vegetation consists of white cedar, spruce, tamarack, white pine, red maple, tagalder, and elm. In Florence County, Edwards muck is known only in Sec. 26, T.41N., R.15E., in the vicinity of metamorphosed limestone outcrops. These soils are classified in the Bog great soil group. A soil profile description follows:

0″–16″ (0–41 cm)	O_1	Black (5YR 2/0) muck; granular; well decomposed woody above to fibrous below; calcareous; abrupt, smooth boundary.
16″–17″ (41–43 cm)	O_2	Dark reddish-brown (5YR 3/3) peaty muck, turning darker upon exposure; calcareous; abrupt, smooth boundary.
17″–18″ (43–46 cm)	D_{1g}	Gray (10YR 6/1) very fine sandy loam marl; weak, very thin platy to weak, fine, subangular blocky; friable; calcareous; abrupt, smooth boundary.
18″–19″ (46–48 cm)	D_{2g}	Very pale brown (10YR 7/3) very fine sandy loam marl; weak, very thin platy to weak, fine, subangular blocky; calcareous; gradual, smooth boundary.
19″–33″ (48–84 cm)	D_{3g}	Pale brown (10YR 6/3) very fine sandy loam marl; massive; calcareous.

Type location: Steuben County, Indiana. Series established: Ogemaw County, Michigan, 1923. Source of name: Town of Edwards in Ogemaw County, Michigan.

EMMERT SERIES (No. 13 on the soil map)

General Description. The Emmert series includes shallow, acid stony soils over deep gravel and sand ridges.

Detailed Description. This series includes droughty soils on hilly to rolling relief and on stony, coarse, acid outwash and inwash, kames, eskers, and esker-like ridges. Well defined esker-like ridges are quite spectacular in Florence County. They occur in groups exhibiting roughly parallel or intertwined arrangements. Original vegetation included red and white pine, balsam fir, hemlock, yellow birch, maple. These soils are classified as weak Podzols intergrading to Regosols. A subsoil (B_{hir}) may be present at a depth of 5″ to 10″. It is overlain by both a lighter brown layer (A_2) horizon) and a dark surface layer (A_1 horizon). This soil consists of 20% to 80%

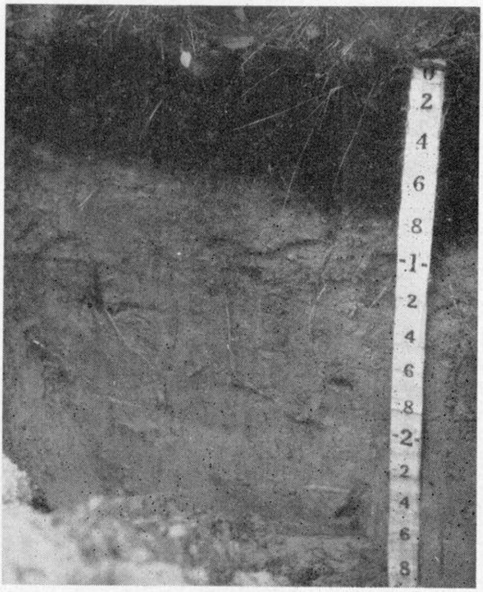


Figure 19. This is Edwards muck, shallow phase (unit number 15 on the soil map), with nine inches of muck resting on nearly white marl (9″–12″) on slightly iron-stained marl (12″–24″) on nearly white marl (24″–33″). The marl is largely calcium carbonate, and is an unusual deposit in the region of Precambrian rocks. Nearby hills contain metamorphosed limestones, from which groundwaters have evidently derived the material necessary for the marl deposit.

gravel, stones, cobbles, by volume. Slope gradients usually lie between 10% and 60%. Associated soils are Vilas, Pence, Omega, Crivitz, Iron River, Fence, and peat. This soil was observed in the S.W.¼S.W.¼ Sec. 17, T.38N., R.17E. A soil profile description follows:

1½″–½″ (3.8–1.3 cm)	A_{oo}	Yellow (10YR 7/8) leaf litter.
½″–0″ (1.3–0 cm)	A_o	Black (5YR 2/1) humus.
0″–4″ (0–10 cm)	A_1	Dark brown (7.5YR 3/2) gritty, stony, cobbly fine sandy loam to coarse silt loam; weak, fine granular structure; friable, between the coarse fragments; 20% cobbles and gravels by volume; many fine roots; clear, smooth boundary; pH 6.0.
4″–5″ (10–13 cm)	A_2	Brown (10YR 4/3) stony, gravelly fine sandy loam to sandy loam; single grain; somewhat friable to loose; about 30% gravel, stones and cobbles by volume; clear, wavy boundary; pH 6.2. This horizon is discontinuous, horizontally.
5″–10″ (13–25 cm)	B_{hir}	Brown to dark brown (7.5YR 4/4) gravelly and cobbly fine sandy loam to sandy loam; gravels and stones occupy about 30% of the horizon by volume; soft, very weak, medium subangular blocky structure between coarse fragments; friable; many roots; one boulder 16 inches in diameter occurred in this horizon; clear, smooth boundary; pH 5.8.
10″–30″ (25–76 cm)	C	Dark yellowish-brown (10YR 4/4) cobbly, stony loamy fine sand to medium sand; 50% cobbles and gravels by volume; soft and loose between coarse fragments; single grain; few roots present; pH 5.9.

Type location: Mille Lacs County, Minnesota, or S.W.¼ Sec. 4, T.36N., R.5E., Oneida County, Wisconsin. Series established: Mille Lacs County, Minnesota, 1927. Source of name: Emmert Tower in St. Louis County, Minnesota.

FENCE SERIES (No. 14 on the soil map)

General Description. The Fence series includes well drained, deep, acid, medium textured soils.

Detailed Description. This series includes soils formed from 18″ to 42″ in the normal phase, and from 42″ to 66″, in the deep phase, of very fine sand and coarse silt overlying acid very fine sand, fine sand, sand, and silt. The deep phase may be underlain by outwash gravel or by glacial till. It seems likely that bodies of these soils which lie in basins, such as that near the village of Fence, have formed in local lacustrine materials deposited during the glacial period. Natural drainage or aeration of the Fence soils is good. The original vegetation included hemlock, balsam fir, yellow birch, hard maple. These soils are classified as minimal and medial Podzols with underlying A'_{2x} and B'_{tx} horizons reminiscent of a Gray-Brown Podzolic soil. The Podzol B horizon begins at a depth of about 4″ and carries down about 6″, with maximum contents of about 20% clay, 60% silt, and 10% organic matter. Above this is a pale layer (A_2 horizon) containing about 10% clay, 70% silt, and 4% organic matter and pounds of available nutrients in the amounts of about 175 lbs. of nitrogen, 37 lbs. of phosphorus, and 95 lbs. of potassium in the virgin soil. The clay contents of the horizons of the Gray-Brown Podzolic-like subsoil horizons are about 10% for the A'_{2x} and 13% to 19% for the B'_{tx}. Slope gradients are usually less than 3% but may range up to 30% locally. See Table XVI for more information. Fence soils occur not only on level plains in basins of the upland, but also in narrow, elongated depressions between esker-and drumlin-like ridges, as in the S.E.¼ of Sec. 19, T.40N.,

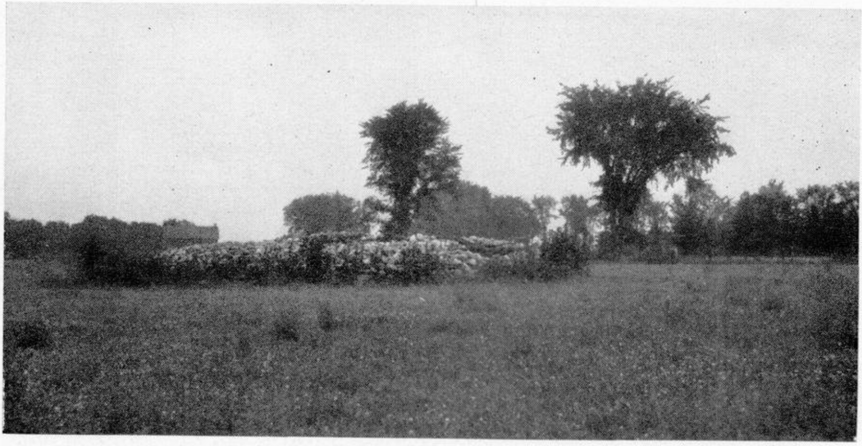


Figure 20. This is Fence silt loam, a productive soil included in unit number 14 on the soil map. This field is unusual because of the large number of stones which were found on the surface of the soil.

R.15E. Stone piles occur in some fields on this soil, as south of the village of Fence. Associated soils are Stambaugh, Goodman, Iron River, Elderon, Emmert. This soil was observed on August 1, 1961 on a 2% slope in the N.E.¼N.E.¼ Sec. 3, T.40N., R.16E. A profile description follows:

3″–2″ (8–5 cm)	A_{oo}	Litter of aspen and elm leaves
2″–0″ (5–0 cm)	A_o	Dark reddish-brown (5YR 2/2/2–1) humus; pH 6.5; clear, smooth boundary.
0″–2″ (0–5 cm)	A_1	Dark reddish-brown (5YR 2/2) coarse silt loam; weak, medium granular; very friable; pH 5.5; abrupt, wavy boundary.
2″–4″ (5–10 cm)	A_2	Grayish-brown (10YR 5/2) silt loam; weak thin platy; very friable; pH 6.1; abrupt, wavy boundary.
4″–7″ (10–18 cm)	B_{hir}	Dark brown (7.5YR 4/4) silt loam; weak, medium, subangular blocky; friable pH 6.0; clear, smooth boundary.
7″–14″ (18–36 cm)	B_{ir}	Dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky; friable; pH 5.4; gradual, smooth boundary.
14″–18″ (36–46 cm)	A'_{2x}	Brown (10YR 5/3) silt loam to silt; weak, medium platy; hard when dry; friable when moist; pH 5.7; weak fragipan; abrupt, irregular boundary.
18″–26″ (46–66 cm)	A'_{2x} & B'_{tx}	Tongues of pale brown (10YR 6/3), weak, medium platy, vesicular silt of pH 5.3 penetrating and surrounding masses, below, of brown (7.5YR 5/4–4/4) weak, medium, angular blocky heavy silt loam of pH 5.3; weak fragipan horizon; abrupt, irregular boundary.
26″–30″ (66–76 cm)	B'_{tx}	Dark brown, (7.5YR 4/4) heavy silt loam; moderate fine to medium angular blocky; firm; pH 5.5; weak fragipan, gradual, smooth boundary.

30″–35″ (76–89 cm)	B'_3	Strong brown (7.5YR 5/6) mottled with brown (7.5YR 5/4–5/2) sandy loam; moderate fine to medium, angular blocky; friable; pH 5.4; this is apparently developed from the upper part of a distinct geologic deposit underlying the silty overburden; gradual, smooth boundary.
35″–40″ (89–102 cm)	C_1	Brown (7.5YR 4/4–5/4) coarse silt loam to very fine sandy loam; massive; pH 5.2; this appears to be a geologic stratum distinct from the overlying two.
40″–90″ (102–229 cm)	C_2	Yellowish-brown (10YR 5/4) fine sand; single grain; loose; pH 6.0; with reddish-brown (5YR 4/3) silt loam bands ½ inch thick lying at a 30° angle, and having a pH of 4.8; roughly parallel to these bands are dark yellowish-brown lenses (10YR 4/4) of fine sand with pH 5.0; clear, wavy boundary.
90″–120″ (229–317 cm)	C_3	Dark brown (10YR 4/3) loamy sand to sandy loam; single grain; friable; pH 5.8; this horizon was wet on Aug. 14, 1959.

Type location: N.W.¼N.W.¼ Sec. 26, T.40N., R.15E. Series proposed: Florence County, Wisconsin, 1958. This series is tentative. Source of name: Village in Florence County, Wisconsin.

GAASTRA SERIES (No. 1 on the soil map)

General Description. The Gaastra series includes imperfectly drained, moderately deep, acid, medium textured soils of depressions in the glacial upland.

Detailed Description. This series includes imperfectly drained soils, developed on lower slopes and in depressions, from 30″ to 60″ of silty material overlying reddish-brown sandy loam to loam glacial till. Original vegetation included hard maple, yellow birch, hemlock. These are classified as imperfectly drained medial Podzols. The subsoil (B_{hir} horizon) begins at a depth of about 10″, with about 15% clay, 70% silt, and 2% organic matter. Above the B horizon is a pale silty layer (A_2 horizon) with about the same amounts of clay and silt, but with somewhat less organic matter than the B_{hir} horizon. Slopes are usually less than 3%, but where seepage is active may go as high as 6%. Some bodies of Gaastra are stony. Several bodies of similar soil were found which had a dark grayish-brown (10YR 2/1–3/1) A_1 horizon 6″ to 13″ thick. Associated soils are Goodman, Cable, Wakefield, Iron River. This soil was observed in the N.W.¼ Sec. 14 T.40N., R.15E. A soil profile description follows:

1½″–½″ (4–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Black humus.
0″–½″ (0–1.3 cm)	A_1	Very dark gray (10YR 3/1) silt loam; weak very fine granular; friable; pH 5.5; clear, irregular boundary.
½″–7″ (1.3–18 cm)	A_{2g}	Gray (10YR 6/1–6/2) silt loam, 5% mottled with brown (10YR 5/3–5/2) weak, fine subangular blocky to weak, medium platy; very friable; pH 5.5; clear irregular boundary.
7″–14″ (18–36 cm)	B_{hirg}	Dark brown (7.5YR 4/4) mottled pinkish-gray (7.5YR 6/2) and strong brown (7.5YR 5/6), silt loam; weak, medium angular blocky; friable; pH 5.5; clear, wavy boundary.
14″–30″ (36–76 cm)	A'_{2x}	Pale brown (10YR 6/3) mottled with brown (7.5YR 5/4) silt loam; moderate, medium platy; firm, but becomes friable under pressure; pH 5.5; abrupt, irregular boundary.

30″–40″ (76–102 cm)	B'_{tx}	Brown (7.5YR 5/4) silt loam, with tongues and spots of pale brown (10YR 6/3); weak, medium to fine platy; firm, but suddenly shatters under pressure between the fingers; pH 5.7; clear, irregular boundary.
40″–50″ (102–127 cm)	D_g	Dark grayish-brown (10YR 4/2) light loam, mottled light brownish-gray, yellowish-brown and dark yellow-brown (10YR 6/2, 5/6, 4/4); massive to weak, platy and subangular blocky; pH 6.0.

Type location: N.W.¼N.W.¼N.E.¼ Sec. 8, T.42N., R.34W., Iron County, Michigan. Series established: Iron County, Michigan, 1930. Source of name: Village in Iron County, Michigan.

GOODMAN SERIES (Nos. 1, 2, 4, and 5 on the soil map)

General Description. The Goodman series includes well drained, moderately deep, acid soils of medium texture overlying stony loam substratum.

Detailed Description. This series includes soils formed under forest vegetation from 2′ to 3½′ of silty material overlying acid, reddish-brown sandy loam to loam till on nearly level to rolling uplands. In Florence County there are some bodies of this soil overlying clay loam till. Natural drainage or aeration has been good. The original vegetation included hemlock, balsam fir, yellow birch, and hard maple. These soils are classified as medial Podzols developing in the deep A horizon of a texturally differentiated profile. The subsoil (B_{hir}) of the Podzol begins at a depth of about 4″ and continues downward about 10″, with maximum contents of about 15% clay, 70% silt, and 4% organic matter. Above this B horizon is a pale, silty layer (A_2 horizon) containing about the same amounts of clay and silt, but somewhat less organic matter than the B. Below the Podzol B is a pale silt loam horizon (A'_{2x}) which is a weak fragipan considered to be the lower part of an A_2 horizon which is being invaded by the Podzol B from above. This pale horizon contains about 12% clay and 55% silt, with 0.5% organic matter. Below this pale horizon is a second B horizon (B'_{tx}) which also has features of a weak fragipan, and which contains about 20% clay, 55% silt, and 0.5% organic matter. The boundary between the A'_{2x} and B'_{tx} horizons is a transition zone with spots of the B surrounded by or nearly surrounded by the A_2 horizon which tongues down from above. Slope gradients range from 2% to about 12%. Long gentle slopes with gradients of 2% and 3% are common. See Table XVII for additional data. Associated soils are Gaastra, Iron River, Wakefield, and Stambaugh. The following description was made in the S.E. corner of Sec. 23, T.40N., R.15E.

2″–1½″ (5–4 cm)	A_{00}	Leaf mat.
1½″–0″ (4–0 cm)	A_0	Very dark gray (5YR 3/1) highly decomposed organic matter; abundant fine roots; abrupt, wavy boundary; pH 6.0.
0″–4″ (0–10 cm)	A_2	Reddish-gray (5YR 5/2) silt loam; moderate, medium platy to weak, fine subangular blocky structure; very friable; many roots; abrupt, smooth boundary; pH 5.7.
4″–7″ (10–18 cm)	B_{hir}	Reddish-brown to dark reddish-brown (5YR 4/4–3/4) silt loam; moderate, medium subangular blocky structure; friable; abundant fine roots; clear, smooth boundary; pH 5.0.
7″–14″ (18–35 cm)	B_{ir}	Brown to dark brown (7.5YR 4/4) silt loam; weak, medium subangular blocky; very friable; fewer roots; clear, smooth boundary; pH 5.4.

14″–18½″ (35–46 cm)	A'_{2x}	Brown (7.5YR 5/4) with light yellowish-brown (10YR 6/4) coatings on ped faces; rubs to yellowish-brown (10YR 5/4), silt loam; compound, moderate, coarse platy to weak, very fine angular blocky structure; finely vesicular firm and slightly brittle, very friable when crushed; clear, wavy boundary; pH 5.4.
18½″–22½″ (46–57 cm)	A'_{2x} & B'_{tx}	Brown to yellowish-brown (7.5YR–10YR 5/4) ped interior with coatings of light yellowish-brown (10YR 6/4) and some spots of brown to dark brown (7.5YR 4/4) silt loam; moderate, medium angular blocky structure; vesicular; firm and brittle, friable when crushed; clear, wavy boundary; pH 5.1.
22½″–28½″ (46–72 cm)	B'_{tx}	Brown to dark brown (7.5YR 4/4) with strong brown (7.5YR 5/6) coatings on peds, heavy silt loam; moderate, coarse platy to moderate, fine, subangular blocky structure; firm and brittle, friable when crushed; abrupt, smooth boundary; pH 5.0.
28½″–35″ (72–89 cm)	B'_{tx} & D_{1x}	Reddish-brown (5YR 4/4) heavy loam; moderate, medium angular blocky structure; vesicular; firm and slightly brittle; crushes to single grain; many reddish-brown (5YR 5/4) and dark reddish-brown (5YR 3/4) clay coatings; clear, smooth boundary; pH 5.2.
35″–45″ (89–114) cm)	B'_{3x} & D_2	Reddish-brown (5YR 4/3) heavy loam; massive and firm to weak, medium, subangular blocky structure; friable and single grained when crushed; patchy clay flows; clear, wavy boundary; pH 5.4.
45″–60″+ (114–152 cm)	D_3	Reddish-brown (5YR 4/3) loam till; massive to weak, coarse platy structure; crushes to single grain; pH 5.9.

Type location: N.E.¼N.W.¼ Sec. 26, T.37N., R.19E., Marinette County, Wisconsin. Series proposed: Marinette County, Wisconsin, 1954. Series is tentative. Source of name: Village in northwestern Marinette County, Wisconsin.

"GRANITIC" ROCKLAND (No. 17 on the soil map)

General Description. This miscellaneous land unit includes outcrops of granite-like bedrock and associated patches of soils ranging in depth from less than an inch to more than 10′.

Detailed Description. This is not a soil, but is a miscellaneous land type, consisting largely of glacially-smoothed rock outcrops of metamorphosed Precambrian rocks, associated with Pence, Vilas, Ontonagon, Iron River, Stambaugh, and Spalding soils. "Granitic" rockland is located chiefly in the southeastern part of the county and is formed on metamorphosed volcanic rocks (Figure 8). Figure 48 shows a typical view of a rock outcrop, and Figure 22 shows a closer view of a patch of soil on a rock outcrop. This patch of soil ranges up to 3″ or 4″ in thickness and consists of debris from lichens, moss, grass, and small shrubs, mixed with disintegrated bedrock. It is a desert-like, droughty soil, unclassified and little studied, which undergoes extreme changes in temperature and moisture content not only through the seasons, but also from hour to hour in a single day. The bedrock outcrops were presumably smoothed by glacial ice about 16,000 years ago, if not during early glaciation. It is not known whether the vegetative cover in the past has been of the same kind and density as at present. Lichens is said to grow 1/50″ per year. If so, the age of some of the circular patches of lichens on the rock outcrops is about 200 years.

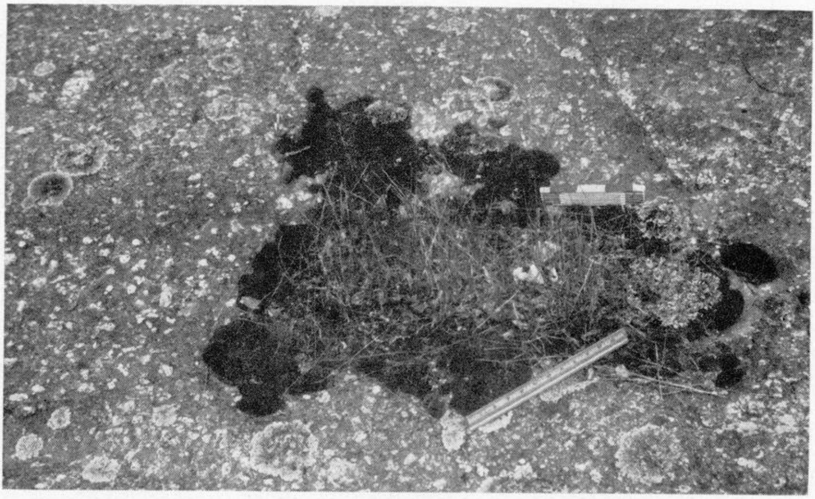


Figure 21. This is a patch of soil formed on an outcrop of "granitic" bedrock (unit number 17 on the soil map). This unnamed soil has a maximum thickness of four inches and consists of organic matter mixed with "granitic" sand and gravel and some wind-blown material. Vegetation consists of lichens, moss and grasses which can withstand the great changes in conditions of temperature and moisture which characterize the site. The surface of the rock around the patch of soil is spotted with circular patches of lichens one to three inches across, and exposed feldspar crystals about an half inch across. The foot-rule indicates the scale.

GREENWOOD SERIES (No. 16 on the soil map)

General Description. The Greenwood series includes deep, acid peats without forest cover.

Detailed Description. This series includes organic soils formed from acid mossy and fibrous organic materials more than 42" deep. Ground water has been stagnant, rather than moving, as in most cedar bogs. Original vegetation, which continues today on most bodies of these soils, is leatherleaf, sphagnum moss, wintergreen. Scattered, small, stunted black spruce trees occur in places. These soils are classified as Bog soils. Organic matter content usually ranges from 70% to 100%. Associated soils are the Spalding and Dawson. Slopes are usually less than 2% in gradient. Microrelief of the bog surface may be very irregular. This soil was observed in the N.E.¼ Sec. 21, T.38N., R.16E. A profile description follows:

3"–0" (8–0 cm)	0^{+}	Sphagnum moss.
0"–3" (0–8 cm)	0_1	Light olive brown (2.5YR 5/4) moss peat; massive; spongy; pH 4.5; abrupt, smooth boundary.
3"–23" (8–59 cm)	0_2	Dark reddish-brown (5YR 3/4) fibrous moss peat; massive; spongy; pH 4.5; abrupt, smooth boundary.
23"–36" (59–92 cm)	0_3	Vary dark reddish-brown (5YR 2/2) fibrous peat; spongy; massive; to weak, coarse platy; pH 4.5; gradual, wavy boundary.
36"–50" (92–127 cm)	0_4	Reddish-brown (5YR 4/4) to yellowish-brown (10YR 5/6) fibrous peat; massive; pH 4.8; abrupt, smooth boundary.

50″–53″ (127–135 cm)	D_g	Gray (2.5YR 6/0) sandy loam.

Type location: N.E.¼S.W.¼ Sec. 5, T.37N., R.3W., Sheboygan County, Michigan. Series established: Ogemaw County, Michigan, 1923. Source of name: Railroad siding in Ogemaw County, Michigan.

HIAWATHA SERIES (Nos. 4, 5, 11, and 12 on the soil map)

General Description. The Hiawatha series includes somewhat droughty, deep, acid, loamy sands, with weakly cemented spots in the subsoil.

Detailed Description. This series includes sand and loamy sand soils developed from deep acid sandy glacial drift. Natural drainage or aeration conditions have been excessive, and the original vegetation includes jack, white, and red pine. These soils are classified as medial Podzols, with horizonation more distinct than in the Vilas series, but less distinct than in the Au Train series. The subsoil (B_{hir}) begins at a depth of about 4″ and continues downward through a weak, incipient fragipan or "coherent" pan about 40″, with maximum contents of about 8% clay, 12% silt, and 2% organic matter. The B_{hir} horizon is wavy with tongues extending downward as much as a foot or two into the substratum, and with corresponding invasions from above by the A_2 horizon, apparently along old root channels. The latter horizon is a bleached sand layer containing about 2% clay and 2% silt. Soil types include sand, loamy sand, loamy fine sand, and fine sand. Slope gradients usually range between 2% and 25%. Associated soils are Vilas, Omega, Au Train, Emmert, Au Gres, peat.

In southeastern Florence County there are profiles of Hiawatha 42″ to 66″ deep over reddish-brown, calcareous loam to clay glacial drift.

An unnamed, related soil was observed in the N.W.¼ Sec. 14, and in the S.E.¼ Sec. 24, T.38N., R.18E. which has a profile similar to the Hiawatha to a depth of 2′, where a reddish-brown loam till was encountered which was high in content of boulders and stones of dark igneous and metamorphic rock: A_{oo}; A_o; A_2, 0″–6″, 5YR 6/1 very fine sand, pH 5.5; B_{irh1} 6″–8″, 5YR 3/4, slightly cemented fine sandy loam; pH 5.8; B_{irh2} 8″–24″, 7.5YR 4/4 cemented loamy sand; pH 6.0; D 24″–100″, gray bouldery till with filling between stones of 2.5YR 3/2–4/2 loam.

The Hiawatha soil was observed in the N.E.¼N.E.¼ Sec. 24, T.40N., R.17E. A soil profile description follows:

2½″–2″ (6–5 cm)	A_{oo}	Reddish-brown (5YR 5/4) pine needle litter; pH 5.5; abrupt smooth boundary.
2″–0″ (5–0 cm)	A_o	Reddish-black (2.5YR 2/1) decomposing forest litter with many medium roots; pH 4.5; abrupt, smooth boundary.
0″–4″ (0–10 cm)	A_2	Weak red (2.5YR 5/2) sand; single grain and massive; loose; not compact; nearly 2% organic matter; pH 4.7; abrupt, wavy to irregular boundary.
4″–6″ (10–15 cm)	B_{hir1}	Very dusky red (2.5YR 2/2) sandy loam; weak, medium, subangular blocky; slightly coherent, exhibiting ½-inch soft aggregates of weak, very coarse granular structure; very friable; about 3% organic matter; pH 4.5; abrupt, wavy to irregular boundary.
6″–8″ (15–20 cm)	B_{hir2}	Dark red (2.5YR 3/6) loamy sand; very weak, medium, subangular blocky; friable; pH 4.5; abrupt, wavy boundary.
8″–16″ (20–41 cm)	B_{ir_1}	Red (2.5YR 4/8) loamy sand; weak, coarse, subangular blocky; friable; pH 5.0; abrupt, wavy boundary.
16″–24″ (41–61 cm)	B_{ir_2}	Dark red (2.5YR 3/8) loamy sand to sand; weak coarse, subangular blocky; friable; somewhat cemented; pH 5.5; abrupt, wavy boundary.

24″–42″ (61–107 cm)	B_{3x}	Brown (7.5YR 5/4) sand; very weak, coarse subangular blocky; somewhat firm; friable suddenly when pressed between the fingers; hard, somewhat cemented, when dry; pH 6.3; clear wavy boundary.
42″–60″ (107–152 cm)	C_{1g}	Strong brown (7.5YR 5/6) with some mottles of yellowish-red (5YR 5/6); very weak, coarse, subangular blocky; slightly cemented; pH 5.8; water table stood at 48″ (122 cm) on June 20, 1961; clear, wavy boundary.
60″–124″ (152–315 cm)	C_{2g}	Reddish-brown (5YR 5/4) slightly mottled with yellowish-red (5YR 5/6) sand; massive; loose; pH 6.8.

Type location: N.E.¼ Sec. 3, T.50N., R.37W., Ontonagon County, Michigan. Series established: Alger County, Michigan, 1929. Source of name: Village in Schoolcraft County, Michigan.

HIBBING SERIES (Nos. 4 and 5 on the soil map)

General Description. The Hibbing series includes moderately well drained, deep clay soils containing a few stones and having a limey clay substratum at depths of 2′ to 4′.

Detailed Description. This series includes moderately well drained soils formed from less than 8″ of silty material over slightly calcareous or dolomitic silty clay or clay till which resembles in many respects the glacial lake sediments from which the Ontonagon soils are developed. The original vegetation included hemlock, white and red pine, yellow birch, hard maple. These soils are classified as Gray Wooded soils with a silty, bleached surface horizon (A_2) and a clay-rich subsoil with clay skins on the ped surfaces. The subsoil (B) begins at a depth of about 5″ and continues downward about 2′ with maximum contents of 42% clay, 45% silt, and 0.2% organic matter. Just above this is the bleached A_2 with about 17% clay, 52% silt, and 0.5% organic matter. See Table XVII for more information. Slopes range from 1% to 50%. Soil types include loam, silt loam, silty clay loam, and silty clay. Patches of Podzol soils occur in association with Hibbing, where more than 6″ of silty or loamy covering occurs on the clayey subsoil. Associated soils are Wakefield, Superior, Ontonagon, Zim, Tromald. This soil was observed in the S.W.¼N.W.¼ Sec. 15, T.39N., R.18E., and in the S.E.¼N.E.¼ Sec. 3, T.38N., R.18E. A profile description follows:

2″–½″ (5–1.3 cm)	A_{00}	Leaf litter.
½″–0″ (1.3–0 cm)	A_0	Dark humus.
0″–1″ (0–2.5 cm)	A_1	Dark gray (10YR 4/1) silt loam; moderate, fine and medium granular; friable; pH 6.5; abrupt, irregular boundary.
1″–6″ (2.5–15 cm)	A_2	Pinkish-gray (7.5YR 6/2) gritty silt loam; moderate, medium platy to weak, fine, subangular blocky; vesicular; very friable; pH 5.7; abrupt, irregular boundary.
6″–9″ (15–23 cm)	A_2 and B_t	Light reddish-brown (5YR 6/3) friable silty material coating irregular blocky peds of plastic reddish-brown (5YR 5/4) silty clay; moderate, medium blocky; pH 5.7; abrupt, irregular boundary.
9″–15″ (23–38 cm)	IIB_{t1}	Reddish-brown (2.5YR 4/4) with slightly lighter colored (2.5YR 5/4) clay films, silty clay loam; moderate, fine to medium, subangular blocky; firm; pH 5.8; gradual, smooth boundary.
15″–32″ (38–81 cm)	IIB_{t2}	Same color as above, but with thicker clay films; silty clay till; strong, fine to medium, angular blocky; firm; pH 6.5; gradual, smooth boundary.

Figure 22. This is a view of Iron River stony loam and "Granitic" Rockland in the S.E.¼ of section 15, T.39N., R.17E.

32″–36″ 81–92 cm)	C_1	Reddish-brown (2.5YR 4/4) silty clay till; moderate, fine, subangular blocky and fine prismatic; pH 7.8; a few pebbles of dolomite are present; gradual, smooth boundary.
36″–48″ (92–122 cm)	C_2	Reddish-brown (2.5YR 5/4) silty clay till with light, reddish-brown (2.5YR 6/4) lime streaks; moderate, fine, subangular blocky; very firm; calcareous or dolomitic.

Type location: S.W.¼S.W.¼ Sec. 27, T.136N., R.26W., Crow Wing County, Minnesota. Series established: Pine County, Minnesota, 1935. Source of name: City in St. Louis County, Minnesota.

IRON RIVER SERIES (Nos. 1, 2, 3, 4, 6, 9, 13, 17 on the soil map)

General Description. The Iron River series includes deep, well drained, acid, somewhat stony medium textured soils of rolling glacial uplands.

Detailed Description. This series includes well drained soils formed under forest vegetation on undulating to rolling acid, sandy glacial till, which may have a silty covering as much as 2′ thick. The original vegetation included hemlock, white and red pine, balsam fir, yellow birch, hard maple, iron wood. These soils are classified as medial Podozls. The subsoil (B) begins at a depth of about 3″ and continues downward nearly a foot, with maximum contents of about 10% clay, 50% silt, and 4% organic matter. All or part of this horizon has formed in glacial till, and is more strongly developed in loam and sandy loam material than in silt loam. Above this horizon is a bleached layer (A_2) with a somewhat lower content of organic matter. Below the Podzol solum is a weakly developed Gray-Brown Podzolic sequence consisting of a pale, platy horizon (A'_{2x}) over a weak textural B horizon (B'_t). For more information, see Table XVII. Rock outcrops occur in association with Iron River soils. Near the center of Section 36, T.40N., R.18E., west of Keyes Lake, northfacing sides of rock outcrops show pillow lavas. The Iron River soil was observed in the S.W.¼S.W.¼ Sec. 18, T.39N., R.17E. A profile description follows:

1½″–½″ (4–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Black humus.
0″–2″ (0–5 cm)	A_1	Very dark gray (10YR 3/1) silt loam; weak, fine granular; very friable; pH 6.0; abrupt, wavy boundary.
2″–3″ (5–8 cm)	A_2	Grayish-brown (10YR 5/2) silt loam; weak, medium granular; very friable; pH 5.0; abrupt, wavy boundary.
3″–10″ (8–25 cm)	B_{hir}	Dark brown (7.5YR 3/4) loam; weak, medium granular to blocky; friable; 5% stones by volume; pH 4.5; clear, wavy boundary.
10″–18″ 25–46 cm	A'_{2x}	Yellowish-brown (10YR 5/4) stony, sandy loam; moderate, fine platy; vesicular; firm when moist; hard when dry; weakly cemented; shatters suddenly under pressure between the fingers; pH 5.4; clear, irregular boundary.
18″–24″ (46–61 cm)	B'_{t1x}	Dark brown (7.5YR 4/4) stony sandy loam; weak to moderate, medium, subangular blocky; firm to friable; weakly cemented; with tongues of platy A'_2 extending down into it. pH 5.4.
24″–30″ (61–76 cm)	B'_{t_2}	Brown (7.5YR 5/4) stony sandy loam; massive to weak, medium subangular blocky; friable to firm; pH 5.0; clear irregular boundary.
30″–34″ (76–86 cm)	C	Dark brown (7.5–10YR 4/4) stony sandy loam till; massive; pH 5.0.

Type location: S.W. corner, Sec. 28, T.36N., R.13E., Forest County, Wisconsin. Series established: Town of Iron River, Iron County, Michigan, 1930. Source of name: Town of Iron River, Iron County, Michigan.

LINWOOD MUCK (No. 15 on the soil map)

General Description. The Linwood series includes acid, shallow to moderately deep muck and peat.

Detailed Description. This series includes soils formed from 12″ to 42″ of muck and peat over loam glacial drift. Original vegetation included spruce, tamarack, elm, tagalder, willow, marsh sedges, and grasses (see Figure 23). Muck formed by a process of alteration of organic materials from these plants until organic particles are no longer recognizable to the naked eye. Some mucks form in place from peat (see Greenwood and Spalding) and some are formed by deposit of organic and mineral materials by streams at flood stage. Locally beaver dams and ponds favor the development of muck and peat bodies. These soils are classified in the Bog great soil group. Organic matter contents are more than 30% and range up to about 70% for the profile above the D horizon. This soil is most extensive in Florence County along the Brule River. This soil was observed in the N.E.¼S.E.¼ Sec. 28, T.41N., R.16E., and in the S.W.¼ Sec. 34, T.41N., R.15E. A profile description follows:

2″–0″ (5–0 cm)	A_{oo}	Sedge and tree litter.
0″–6″ (0–15 cm)	O_1	Very dark brown (10YR 2/2) silty muck; slippery; weak fine granular; many sedge roots; pH 7.5; gradual, smooth boundary.

6″–12″ (15–31 cm)	O_2	Very dark brown (10YR 2/2) silty muck mottled 2% dark reddish-brown (5YR 4/3); a small rusty iron "pipe" ½″ long and ⅛″ in diameter was noted in a root hole; weak fine granular; pH 7.5; gradual, smooth boundary.
12″–32″ (31–81 cm)	O_3	Black (10YR 2/1) woody peat; soft; pH 7.5; gradual, smooth boundary.
32″–38″ (81–97 cm)	D_{hg}	Black (5YR 2/1) mucky sandy loam, containing many gray (5/1) quartz grains; massive; nonsticky, pH 8.5; non-effervescent with acid except for the ¼″-long shells; stones and gravel present.

Type location: Arenac County, Michigan. Series established: Sanilac County, Michigan, 1955. Source of name: Town in Bay County, Michigan.

MANISTEE SERIES (No. 5 on the soil map)

General Description. The Manistee series includes well drained sands moderately deep over limey clay.

Detailed Description. This series includes soils formed under good natural drainage or aeration conditions from 18″ to 42″ of sand and loamy sand over calcareous or dolomitic reddish-brown silty clay or clay. The original vegetation included hemlock, white and red pine, balsam fir, yellow birch, hard maple. These soils are classified as medial Podzols. The subsoil (B_{hir}) horizon begins at a depth of about 6″ and continues downward through a weak, incipient fragipan (B_3) about 20″, with maximum contents of about 9% clay and 18% silt, 2% organic matter. Above the B horizon is a bleached layer (A_2 horizon) containing about 6% clay and 14% silt and 1.5% organic matter. The substratum contains about 50% clay and 30% to 50% silt. Slope gradients range from 0% to 15%. Associated soils are Ontonagon, Superior,

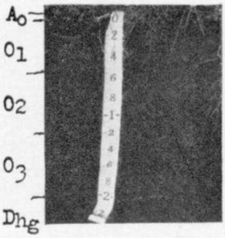


Figure 23. This is Linwood silty muck, a soil composed largely of organic materials in various stages of decomposition. Soil layers (horizons) of organic soils like this one do not show up in a photograph, but can be seen on close examination in the field. Under a thin decomposing litter of grass and sedge leaves (A_0) is a layer of soft, black "paste" interlaced with roots and stems of sedges (O_1). The third layer (O_2) is similar, but with fewer roots; there are some rust-colored "iron stems" surrounding old root channels. Below this is a black woody paste (O_3) and a substratum of black, mucky sandy loam (D_{hg}). The landscape is of an extensive body of mucks and peats with forest cover (unit number 15 on the colored soil map), and without forest cover (unit number 16), in the Brule River valley. Many peat and muck bodies in Florence County occur in undrained pits, unassociated with surface streams.

Rudyard. A profile description follows from the S.E.¼N.W.¼ Sec. 25, T.38N., R.18E.

1½″–½″ (4–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Humus.
0″–½″ (0–1.3 cm)	A_1	Black (5YR 2/1) sand; numerous white sand grains evident; single grain; loose; pH 4.0; abrupt, wavy boundary.
½″–6″ (1.3–15 cm)	A_2	Brown (7.5YR 5/2) sand; single grain to weak medium granular; very friable; pH 5.5; abrupt, wavy boundary.
6″–15″ (15–38 cm)	B_{hir}	Dark brown (7.5YR 4/2) above, to brown (7.5YR 4/4), below, loamy sand; slightly coherent; very weak medium granular; very friable; pH 6.0; abrupt, wavy boundary.
15″–24″ (38–61 cm)	B_{31x}	Brown (7.5YR 5/4) sand, slightly mottled with strong brown and yellowish-brown (7.5YR and 5YR 5/6); somewhat coherent, incipient fragipan; weak, medium angular blocky and platy; friable; pH 6.4; clear, wavy boundary.
24″–30″ (61–76 cm)	B_{32x}	Dark brown (7.5YR 4/2) loamy fine sand; weak medium angular blocky to platy; coherent, weak, incipient fragipan; pH 6.7; clear, wavy boundary.
30″–40″ (76–102 cm)	II B_{33}	Dark reddish-brown (2.5YR 3/4) silty clay; strong, fine subangular blocky; firm; pH 7.5; clear, wavy boundary.
40″–50″ (102–127 cm)	II D	Dusky-red (10R 3/4) clay with pale red (2.5YR 6/2) mottles; strong medium subangular blocky; plastic; dolomitic and calcareous; calcium carbonate accumulations occur in white, granular aggregates.

Type location: N.W.¼N.W.¼ Sec. 19, T.37N., R.2W., Cheboygan County, Michigan. Series established: Manistee County, Michigan, 1922. Source of name: County in Michigan.

MENOMINEE SERIES (No. 5 on the soil map)

General Description. The Menominee series includes well drained sand moderately deep over limey loam.

Detailed Description. This series includes soils developed from 18″ to 42″ of sand and loamy sand over calcareous or dolomitic reddish-brown loam to silty clay loam, under good to moderately good drainage or aeration conditions. Original vegetation included red and white pine, hemlock, hardwoods. These soils are classified as minimal Podzols. The subsoil (B_{hir} and B_x) begins at a depth of about 3″ and continues downward for about 20″ with maximum contents of about 8% clay, 17% silt, 2% organic matter. The lower half of the B horizon is a weak, incipient fragipan ($B_{(x)}$) with practically no organic matter. Above the B horizon is a bleached layer (A_2 horizon) containing about 5% clay, 12% silt, and about 1.5% organic matter. Slope gradients range from 0% to 15%. Associated soils are Superior, Manistee, Rousseau, Ontonagon. This soil was observed in the N.E.¼ Sec. 13, T.38N., R.18E. A soil profile description follows:

1½″–½″ (3.8–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_0	Humus.
0″–½″ (0.1–1.3 cm)	A_1	Black (5YR 2/1) sand; numerous white quartz grains evident; single grain; loose; pH 4.0; abrupt, wavy boundary.

1/2"–3" (1.3–8 cm)	A_2	Dark reddish-gray (5YR 4/2) sand; single grain; loose; pH 4.0; abrupt, wavy to irregular boundary.
3"–6" (8–15 cm)	B_{hir1}	Dark reddish-brown (5YR 3/4) sand; single grain to weak medium granular; loose to very friable; coherent; pH 4.5; clear, wavy to irregular boundary.
6"–12" (15–31 cm)	B_{hir2}	Brown (7.5YR 5/4) sand; single grain; slightly coherent; loose; pH 5.0; clear, wavy to irregular boundary.
12"–24" (31–61 cm)	$B_{(x)}$	Brown (7.5YR 4/4–5/4) sand, somewhat mottled with strong brown (5/6) in the lower part; coherent, weak, incipient fragipan; very friable; pH 5.5; abrupt, wavy boundary.
24"–36" (61–92 cm)	D_1	Reddish-brown (2.5YR 4/4) loam to silty clay loam; moderate medium platy and subangular blocky; firm; dolomitic.

Type location: N.E.1/4 Sec. 13, T.25N., R.10W., Grand Traverse County, Michigan. Series established: Menominee County, Michigan, 1925. Source of name: Menominee County, Michigan.

MOYE SERIES (Nos. 12, 16 on the soil map)

General Description. The Moye series includes imperfectly drained, deep acid fine sands.

Detailed Description. This series includes imperfectly drained soils formed from 18" to 30" of medium to fine sand overlying acid stratified fine sands and sands. Natural vegetation included tagalder, willow, spiraea, tamarack, black spruce. These soils are classified as imperfectly drained minimal to medial Podzols. The subsoil (B_{hir}) begins at a depth of about 3" and continues downward about a foot with contents of about 10% clay, 15% silt, and 3% organic matter. Above the B horizon is a pale mottled layer (A_2 horizon) with a thin dark horizon (A_1) at the soil surface. Soil types include sandy loams and loamy fine sands. Slope gradients are less than 2%. See Table XVII for additional data. This series is thought of as coarser in texture than the Tipler series. Associated soils are Randville, Roscommon, Saugatuck, Pence, Crivitz, and Vilas. This soil was observed in the center of the north half of Sec. 7, T.38N., R.18E. A profile description follows:

2"–0" (5–0 cm)	A_o	Very dark gray (5YR 3/1) fibrous, slightly matted, loose and soft, well decomposed organic matter; many fine roots with some mineral matter mixed in; clear, smooth boundary; pH 5.0.
0"–1" (0–2.5 cm)	A_1	Dark gray to very dark gray (5YR 4/1–3/1) sandy loam; weak fine granular; white quartz grains conspicuous; very friable; abrupt, smooth boundary; high in organic matter with many fine roots; pH 4.5.
1"–3" (2.5–8 cm)	A_2	Reddish-gray (5YR 5/2) with a few faint, medium mottles of reddish-brown and pinkish-gray (5YR 5/3–6/2) light sandy loam; weak coarse angular blocky; friable; clear, wavy boundary; pH 5.0.
3"–4 1/2" (8–12 cm)	B_{hir1}	Dark reddish-brown (5YR 3/3) sandy loam; moderate, medium subangular blocky; friable; rather greasy feeling; a few 1/2" diameter roots and fine roots; clear wavy boundary; pH 5.2.
4 1/2"–10" (12–25 cm)	B_{hir2}	Reddish-brown (5YR 4/4) with a few faint splotches (2.5YR 3/6) of dark red, light sandy loam; weak medium, subangular blocky; loose; clear, smooth boundary; pH 5.3.

10″–16″ (25–41 cm)	B_3	Yellowish-red (5YR 4/6) mottled, common and medium to faint yellowish-red (5YR 5/6), loamy sand; weak, coarse, subangular blocky; loose; clear, smooth boundary; pH 5.5.
16″–20″ (41–51 cm)	C	Reddish-brown (5YR 5/4) mottled, common, coarse, distinct, yellowish-red (5YR 5/6) sand; single grain; wet; abrupt, wavy boundary. pH 5.5.
20″–30″ (51–76 cm)	D	Many prominent mottles, about evenly distributed between light gray (10YR 7/2), yellowish-red and reddish-yellow (5YR 5/8 and 6/8), and strong brown (7.5YR 5/6) loamy fine sand; wet; pH 5.6. Water ran into the pit at about 24 inches. Auger samples taken to 72″ showed very wet, loamy fine sand with pH 5.3–5.4.

Type location: N.E.¼S.W.¼ Sec. 16, T.37N., R.2W., Cheboygan County, Michigan. Series established: Schoolcraft County, Michigan, 1932. Source of name: Town of Arenac County, Michigan.

OMEGA SERIES (No. 10 on the soil map)

General Description. The Omega series includes very droughty, deep acid sands.

Detailed Description. This series includes droughty soils developed from acid glaciofluvial sands, both level and rolling. Original vegetation was largely jack pine. These soils have been classified as minimal Podzols intergrading to Regosols, with upper horizons somewhat disturbed locally. Regosols have no B horizon, and minimal Podzols do have B horizons. Some field men speak of Omega soils as being "too sandy to become Podzols." The subsoil is stained brown (B_{ir}) but is not a definite zone of accumulation of iron, clay, and organic matter. This horizon begins at a depth of about 4″ and continues downward about 2′, with maximum contents of about 4% clay, 10% silt, 0.5% organic matter. Above the B_{ir} horizon are darker sandy layers (A_1 or mixed A_1 and A_2 and A_3), with about the same contents of clay and silt as below, but with as much as 10% organic matter. Soil types are sand, and loamy fine sand. Associated soils are Vilas and Crivitz. The following profile description was made in the S.W.¼N.W.¼ Sec. 4, T.38N., R.18E.

1″–¼″ (2.5–.7 cm)	A_{oo}	Needle litter.
¼″–0″ (.7–0 cm)	A_o	Dark Humus.
0″–2″ (0–5 cm)	A_1	Black (5YR 2/1) loamy fine sand; white quartz grains evident; single grain; loose; pH 4.5; abrupt, wavy boundary.
2″–3″ (5–8 cm)	A_2	Dark reddish-gray (5YR 4/2) loamy fine sand; single grain; loose; pH 4.8; abrupt, wavy boundary.
3″–10″ (8–25 cm)	B_{ir_1}	Dark reddish-brown (5YR 4/3–4/4) fine sand; single grain; loose; pH 5.5; clear, wavy boundary.
10″–16″ (25–41 cm)	B_{ir_2}	Yellowish-red (5YR 5/6) fine sand; single grain; loose; pH 5.8; clear, wavy boundary.
16″–24″ (41–61 cm)	B_3	Brown (7.5YR 5/4–5/6) fine sand; slightly coherent, very friable; pH 5.8; clear, wavy boundary.
24″–40″ (61–102 cm)	C	Reddish-brown (5YR 5/4) fine sand; single grain; loose; pH about 6.0.

Type location: Cloquet Forest Experiment Station, Carleton County, Minnesota. Series established: Iron County, Michigan, 1930. Source of name: Village, St. Louis County, Minnesota.

ONTONAGON SERIES (Nos. 5 and 17 on the soil map)

General Description. The Ontonagon series includes moderately well drained deep clay soils which are usually stone-free, and which are underlain by limey clay substratum at depths of 2½′ to 3½′.

Detailed Description. This series includes soils developed under conditions of good to moderately good natural drainage or aeration from reddish-brown calcareous or dolomitic clay or silty clay of lacustrine origin. These soils are very similar to the Hibbing soils, formed on glacial till of similar texture. The original vegetation included hemlock, white and red pine, yellow birch, hard maple. These soils are classified as Gray Wooded Soils. The subsoil (B_t) begins at a depth of about 5″ and continues downward about 2′ with maximum contents of about 42% clay, 45% silt, and 0.2% organic matter. Above the B_t is a bleached more silty layer with about 30% clay and 55% silt and 0.5% organic matter. Slopes range from 2% to 12%. Associated soils are the Superior, Bibon, Orienta, Zim, Tromald, Hibbing, Bohemian. This soil was observed near the center of Sec. 23, T.38N., R.18E. A soil profile description follows:

1″–¼″ (2.5–.7 cm)	A_{00}	Very dark brown (10YR 2/2) leaf litter; abrupt, smooth boundary.
¼″–0″ (.7–0 cm)	A_0	Black (10YR 2/1) humus; abrupt, smooth boundary.
0″–1″ (0–2.5 cm)	A_1	Dark gray (10YR 4/1) silt loam; moderate, medium granular; friable; pH 5.0; abrupt, wavy boundary.
1″–4″ (2.5–10 cm)	A_2	Pinkish-gray (5YR 6/2) silty clay loam; weak, fine to medium platy and very fine subangular blocky; friable; somewhat vesicular; pH 5.5; clear, wavy boundary.
4″–8″ (10–20 cm)	A_2 & B_t	Tongues of A_2 penetrate down long cracks in the B_t horizon, some isolated pieces of which are completely surrounded by A_2; pH 5.5; clear, wavy boundary.
8″–14″ (20–36 cm)	B_{t_1}	Weak red (2.5YR 4/2) silty clay; moderate, fine, angular blocky; sticky and plastic when wet; slightly vesicular; no clay skins observed; some ped faces coated with light gray silt and dark gray organic stains; pH 5.7; clear, wavy boundary.
14″–25″ (36–64 cm)	B_{t_2}	Weak red (2.5YR 4/2) with spots of dark reddish-brown and reddish-brown (2.5YR 3/4 and 5YR 4/3) silty clay; moderate, fine, angular blocky, and moderate, medium platy; very slightly vesicular; plastic when wet; clay skins cover about 20% of ped surfaces and are weak red in color; pH 8.0; gradual, smooth boundary.
25″–36″ (64–92 cm)	B_{t_3}	Reddish-brown (2.5YR 4/4) silty clay with 50% of ped surfaces covered by weak red (2.5YR 4/2) clay skins; moderate, coarse to medium platy breaking to moderate, medium, angular blocky; plastic when wet; very slightly vesicular; pH 8.0; clear, wavy boundary.
36″–45″ (92–114 cm)	C	Reddish-brown (2.5YR 4/4) silty clay with layers of weak red (2.5YR 4/2) silty clay; massive to moderate, medium platy breaking to moderate, medium, angular blocky; firm; calcareous or dolomitic.

Type location: S.E.¼S.E.¼ Sec. 6, T.150N., R.38W., Ontonagon County, Michigan. Series established: Ontonagon County, Michigan, 1921. Source of name: Ontonagon County, Michigan.

PADUS SERIES (Nos. 2, 3, 4, 6, 7, 8, 9, 10 and 13 on the soil map)

General Description. The Padus series includes moderately deep, acid loams and sandy loams over deep sand and gravel.

Detailed Description. This series includes well drained soils developed from 24″ to 42″ of loam to sandy loam material over acid sand and gravel outwash. The original vegetation included balsam fir, hemlock, hard maple, iron wood, yellow birch. These soils are classified as medial Podzols. The subsoil (B) begins at a depth of about 2″ and continues downward about 18″, with maximum contents of about 12% clay, 45% silt, and 3% organic matter. Above this horizon is a pale layer (A_2) with a slightly lower organic matter content. Below the Podzol solum a brown, platy layer (A'_{2x}) and underlying reddish-brown horizon (B'_{tx}) comprise the visible solum of a Gray-Brown Podzolic-like soil. The B'_{tx} has maximum contents of about 18% clay, 45% silt, and 0.3% organic matter. Slope gradients range from 1% to 15%. Associated soils are Stambaugh, Pence, Crivitz, Iron River, Emmert. This soil was observed in the S.E.¼S.W.¼S.W.¼ Sec. 30, T.39N., R.19E. A soil profile description follows:

2″–½″ (5–1.3 cm)	A_{00}	Yellowish-brown (10YR 5/8) pine needle and leaf litter.
½″–0″ (1.3–0 cm)	A_0	Dark reddish-brown (5YR 3/3) humus.
0″–½″ (0–1.3 cm)	A_1	Very dark gray (5YR 3/1) loam; moderate to very fine granular; friable to soft; pH 6.0; abrupt, smooth boundary.
½″–1½″ (1.3–4 cm)	A_2	Reddish-gray (5YR 5/2) sandy loam; massive to single grain; loose; pH 5.6; abrupt, wavy boundary
1½″–4″ (4–10 cm)	B_{hir}	Reddish-brown (5YR 4/4–3/4) loam; weak, medium, subangular blocky, breaking to weak, fine crumbs; very friable to soft; pH 5.6; clear, wavy boundary.
4″–10″ (10–25 cm)	B_{ir}	Brown (7.5YR 4/4) sandy loam; weak medium, subangular blocky; very friable; pH 5.8; clear, irregular boundary.
10″–14″ (25–36 cm)	A'_{2x}	Brown (7.5YR 5/3) fine sandy loam; weak, medium platy; friable; weakly cemented in moist condition; shatters under pressure; moderately hard on drying; pH 5.7; clear, smooth boundary.
14″–26″ (37–66 cm)	A'_{2x} & B'_{tx}	Interfingering of vesicular, moderate, medium platy fine sandy loam A'_{2x} (pH 5.7) with reddish-brown (5–2.5YR 4/4) weak, medium platy to massive, very friable loam B'_{tx} (pH 5.5); some isolated remnants of B'_{tx} are surrounded by A'_{2x}; clear, smooth boundary.
26″–38″ (66–97 cm)	B'_3	Reddish-brown (5YR 4/3) medium sandy loam; weak, medium, subangular blocky to coarse platy; friable; pH 5.8; smooth, wavy boundary.
38″–44″ (97–112 cm)	B'_3 & D_1	Reddish-brown (5YR 4/4) medium loamy sand; massive to weak coarse platy; friable; pH 6.3; abrupt, wavy boundary.
44″–60″ (112–152 cm)	D_2	Brown (7.5YR 5/4–4/4) medium sand; stratified; loose; there are several ¼-inch thick horizontal bands of dark reddish-brown (5YR 3/4) loamy sand spaced about 6 inches apart; pH 6.3 between bands and pH 6.0 in bands.
60″–84″ (152–213 cm)	D_3	Reddish-brown (5YR 4/4) coarse sand; stratified; loose; pH 6.3.

Type location: S.W.¼ Sec. 17, T.28N., R.13E., Shawano County, Wisconsin. Series proposed: Forest County, Wisconsin, 1960. Source of Name: Railroad Station in southern part of Forest County, Wisconsin.

PENCE SERIES (Nos. 2, 3, 4, 6, 7, 8, 9, 10, 12, 13, and 17 on the soil map)

General Description. The Pence series includes shallow to moderately deep acid sands over deep sand and gravel.

Detailed Description. This series includes droughty soils formed from 15″ to 24″ of loam to sandy loam material, with or without gravel, over acid glacio-fluvial sand, usually with 15% or less of gravel by volume. Upper layers are silty locally. Original vegetation included balsam fir, hard maple, white and red pine, hemlock. These soils are classified as medial Podzols. The subsoil (B_{hir}) begins at a depth of about 3″ and continues down for about 2′ through a weak, incipient fragipan (B_x), with maximum contents of about 10% clay, 40% silt, and 1.5% organic matter in the B_{hir}. Above the B horizons is a shallow, bleached layer (A_2 horizon) containing about the same amounts of clay and silt and organic matter as in the B horizon just below. Slope gradients are from 0% to 30%. See Table XVII for additional information. Associated soils are Omega, Vilas, Hiawatha, Crivitz, Stambaugh. Loam and sandy loam types are common. Silt loams occur locally. The following soil profile description was taken from the N.E.¼N.W.¼ Sec. 29, T.40N., R.19E.

1½″–½″ (4–1.3 cm)	A_{00}	Dark reddish-brown (5YR 2/2) leaf litter; pH 5.5; abrupt, smooth boundary.
½″–0″ (1.3–0 cm)	A_0	Black (5YR 2/1) humus; pH 5.0; abrupt, irregular boundary.
0″–2″ (0–5 cm)	A_2	Gray (5YR 6/1) sandy loam; massive to weak, fine platy; friable; pH 4.8; abrupt, wavy boundary.
2″–6″ (5–15 cm)	B_{hir1}	Strong brown (7.5–5YR 4/6) sandy loam; some gravel present in this and underlying horizons; weak, fine to medium granular; friable; soft; pH 5.2; clear, wavy boundary.
6″–20″ (15–51 cm)	B_{hir2}	Brown (7.5YR 5/4–4/4) sandy loam; weak, coarse platy and weak medium subangular blocky; friable; loose; pH 5.2; clear irregular boundary.

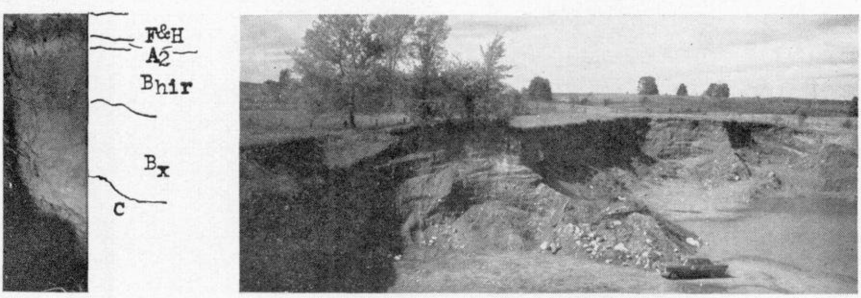


Figure 24. This is Pence loam in the N.E.¼ of Section 28, T.40N., R.18E. Under the organic mat (F and H layers) is a pale A_2 horizon about 2 inches thick; a Brown B_{hir} horizon more than a foot thick; a paler, slightly cemented horizon (B_x); and the C horizon of loose, acid sand and gravel. The landscape shows a large gravel pit excavated in this rolling landscape (unit number 9 on the soil map).

20″–24″ (51–61 cm)	B_x	Reddish-brown (5–7.5YR 5/4) loamy sand with a few dark brown (7.5YR 4/2) concretions; vesicular; moderate, coarse platy; coherent, incipient fragipan which becomes suddenly friable under pressure between the fingers; pH 5.3; clear, wavy boundary.
24″–52″ (61–132 cm)	C_1	Yellowish-red (5–7.5YR 5/6) gravelly medium sand; single grain; loose; pH 6.2; gradual, wavy boundary.
52″–60″ (132–152 cm)	C_2	Brown (7.5YR 4/4–5/4) gravelly medium sand; single grain; loose; pH 6.0.

Type location: S.E.¼S.E.¼ Sec. 31, T.40N., R.1W., Price County, Wisconsin. Series established: Bayfield County, Wisconsin, 1958. Source of name: Village in Iron County, Wisconsin.

PICKFORD SERIES (No. 15 on the soil map)

General Description. The Pickford series includes wet clay soils which are limey at a depth of about 2′.

Detailed Description. This series includes soils developed in poor natural drainage or aeration conditions from calcareous or dolomitic reddish-brown lacustrine clays and silty clays. The original vegetation included hemlock, balsam fir, white and red pine, white cedar, and hard maple. These soils are classified in the Low Humic-Gley great soil group, having A_1 horizons which are shallower than plow-depth, whereas Humic-Gley soils have much thicker A_1 horizons. The subsoil (B_g or C_{1g} horizon) begins at a depth of about 7″ and has maximum contents of about 90% clay, 8% silt, and 1% organic matter. The overlying dark surface soil (A_1 horizon) contains about 28% clay, 70% silt, and 1% organic matter. Slope gradients range from 0% to 2%. Associated soils are Ontonagon, Rudyard, Bergland. This soil was observed in the N.E.¼S.W.¼ Sec. 2, T.38N., R.18E. A soil profile description follows:

2″–1″ (5–2.5 cm)	A_{00}	Needle and leaf litter.
1″–0″ (2.5–0 cm)	A_0	Dark reddish-brown (5YR 2/2) humus.
0″–5″ (0–13 cm)	A_1	Very dark gray (10YR 3/1) silty clay loam; moderate, medium granular to fine, subangular blocky; and strong, coarse prismatic; firm; pH 5.0; clear wavy boundary.
5″–7″ (13–18 cm)	A_{3g}	Gray (5YR 5/1) silty clay, moderate fine blocky; strong, coarse prismatic; firm; pH 5.0; clear, wavy boundary.
7″–14″ (18–36 cm)	C_{1g}	Reddish-brown (2.5YR 4/4) silty clay, mottled, yellowish-red and light yellowish-brown (5YR 4/6, 2.5YR 6/4); strong to medium coarse angular blocky; very firm; pH 6.7; gradual, irregular boundary.
14″–24″ (36–61 cm)	C_{2g}	Pale red (2.5YR 6/2) clay, mottled, reddish-brown, red, and light yellowish-brown (2.5YR 4/4, 5/6, 6/4); weak, coarse angular blocky; moderate, coarse prismatic; dolomitic or calcareous.

Type location: S.W.¼S.W.¼ Sec. 34T.44N., R.1W., Chippewa County, Michigan. Series established: Bayfield County, Wisconsin, 1958. Source of name: Village in Chippewa County, Michigan.

RANDVILLE SERIES (No. 12 on the soil map)

General Description. The Randville series includes droughty deep acid loamy sands.

Detailed Description. This series includes droughty soils formed in acid stratified loamy fine sand, fine sand, and sand. The original vegetation included maple, yellow birch, spruce, balsam fir, white pine. These soils are classified as medial Podzols. The subsoil (B_{hir}) begins at a depth of about 4″ and continues downward about 15″, with maximum contents in the B_{hir} of about 8% clay, 20% silt, and 2% organic matter. Above the B horizon is a pale layer (A_2 horizon) with about the same contents of clay and silt, and a little less organic matter than in the B_{hir}. Soil types include sandy loams and loamy sands. In Florence County stones and boulders occur on and in these soils. Slope gradients are from 0% to 15%. This series is coarser in texture than the Fence series. Associated soils are Vilas and Crivitz. In counties to the north, in Michigan, Marenisco soils over loamy sand glacial till are found in association with Randville. This soil was observed in the S.W.¼ Sec. 16, T.38N., R.19E. A profile description follows:

2″–1″ (5–2.5 cm)	A_{oo}	Dusky red (10R 3/3) to pinkish-gray (7.5YR 6/2) leaf litter, mostly maple. Abrupt, smooth lower boundary.
1″–0″ (2.5–0 cm)	A_o	Weak red (10R 4/2) decomposing leaf and twig litter; abrupt, smooth boundary.
0″–1½″ (0–4 cm)	A_1	Weak red (10R 4/2) light sandy loam to loamy fine sand; fine, moderate crumb structure with many fine roots and much organic matter; slightly friable consistence; pH 6.8; abrupt, smooth boundary.
1½″–4″ (4–10 cm)	A_2	Reddish-gray (10R 5/1) sandy loam to fine sandy loam; weak to medium, moderate, subangular blocky breaking to fine, weak, angular blocks to crumbs; friable; pH 5.2; abrupt, smooth boundary.
4″–14″ (10–36 cm)	B_{hir}	Reddish-brown (5YR 5/4) sandy loam to fine sandy loam; coarse to medium, moderate, angular blocky breaking to fine, medium, subangular blocky; friable; pH 5.5; clear, smooth boundary.
14″–21″ (36–53 cm)	B_{ir}	Reddish-brown (5YR 4/3) sandy loam with some gravel; coarse to medium, moderate, angular blocky breaking to fine, moderate, angular blocks; slightly friable to loose; pH 6.0; clear, smooth boundary.
21″–28″ (53–71 cm)	C_1	Reddish-brown (5YR 4/3) gravelly loamy fine sand; weak, moderate, angular blocky breaking to fine, weak, crumbs to loose grains; pH 5.7; clear, smooth boundary.
28″–37″ (71–94 cm)	C_2	Reddish-brown (5YR 4/4) gravelly loamy sand to fine sand; weak, moderate, angular blocky breaking to loose grains; very slightly friable to loose; pH 5.5; clear, smooth boundary.
37″–45″ (94–114 cm)	C_3	Brown (7.5YR 5/4) loamy fine and medium sand; coarse to medium, moderate, angular blocky; slightly firm; loose when crushed; slightly cemented; pH 5.9. This horizon is stratified.

Type location: Iron County, Michigan. Series established: Iron County, Michigan, 1930. Source of name: Village in Dickinson County, Michigan.

ROSCOMMON SERIES (No. 15 on the soil map)

General Description. The Roscommon series includes wet sands which may be limey at a depth of about 4′.

Detailed Description. This series includes soils formed under conditions of poor drainage from sands and light sandy loams of neutral to calcareous glacial drift. The original vegetation included tagalder, willow, and sedges. These soils are classified in the Low Humic-Gley great soil group. The subsoil (C_g horizon) begins at a depth of about 4″, and contains a maximum of about 10% clay and 10% silt. The overlying dark surface soil (A_1) has about the same particle size distribution, but with about 15% organic matter. Upper horizons are typically acid but may be neutral in reaction as a result of drainage from surrounding slopes. Slope gradients are usually less than 2%. Associated soils are Saugatuck, Hiawatha, Vilas, Au Train. The following soil profile description was taken from the N.E.¼N.W.¼ of Sec. 17, T.38N., R.19E.

3¼″–3½″ (9–8.5 cm)	A_{oo_1}	Leaf litter.
3½″–3″ (8.5–7.7 cm)	A_{oo_2}	Somewhat decomposed leaf litter.
3″–0″ (7.7–0 cm)	A_o	Black muck.
0″–3″ (0–8 cm)	A_1	Black (2.5YR 3/0–2/0) fine sandy loam; massive to weak, fine blocky; soft, friable; pH 6.8; abrupt, wavy boundary.
3″–9″ (8–23 cm)	C_{1g}	Dark grayish-brown (10YR 5/2–4/2) loamy medium sand, mottled dark yellowish-brown (10YR 4/4); massive to weak medium blocky; pH 7.1; soft to firm; abrupt, wavy boundary.
9″–20″ (23–51 cm)	C_{2g}	Olive gray (5Y 4/2–3/2) medium sand, mottled olive brown (2.5Y 4/4), with coatings and stains and tongues of dark gray (2.5Y 4/0–3/0); massive; slightly cemented; pH 6.1; clear, wavy boundary.
20″–30″ (51–76 cm)	C_{3g}	Dark grayish-brown (10YR 4/2) loamy sand above to dark grayish-brown (2.5Y 4/2) sand below; stratified; loose; pH 5.9.

Type location: Arenac County, Michigan. Series established: Sanliac County, Michigan, 1955. Source of name: Arenac County, Michigan.

RUDYARD SERIES (No. 5 on the soil map)

General Description. The Rudyard series includes imperfectly drained clay soils which are limey at depths of 2′ to 3′.

Detailed Description. This series includes soil developed under imperfect natural drainage or aeration conditions from dolomitic or calcareous, stratified lacustrine clays or silty clays. Less than 8″ of silty deposit occurs on these soils. Original vegetation included hemlock, balsam fir, spruce, yellow birch, hard maple, basswood. These soils are classified as imperfectly drained minimal Podzols, grading to Gray Wooded soils, or (if the clay-rich B horizon is considered to be largely geologic in origin) pseudo-Gray Wooded soils. The subsoil (B_t) begins at a depth of about 5″ and continues downward about 6″, with maximum contents of about 45% clay, 50% silt, and 1% organic matter. Above the B horizon is a somewhat pale layer (A_2 horizon) with maximum contents of about 45% clay, 55% silt, and 1% organic matter. Slope gradients are less than 2%. Associated soils are Ontonagon, Pickford, Bohemian, and Brimley. This soil was observed near the center of Sec. 23, T.38N., R.18E. A soil profile description follows:

1″–¼″ (2.5–.7 cm)	A_{oo}	Leaf and needle litter.
¼″–0″ (.7–0 cm)	A_o	Dusky red (10R 3/2) humus.

0″–2″ (0–5 cm)	A_1	Reddish-black (10R 2/1) loam; weak, moderate granular; very friable; pH 5.9; abrupt, wavy boundary.
2″–4″ (5–10 cm)	A_{21g}	Dark gray (2.5YR 4/0) loam, with ½-inch wide spots and streaks of weak red (2.5YR 4/2) occupying about 10% of this horizon; moderate, fine, angular blocky to massive; very friable; pH 6.0; abrupt, irregular boundary.
4″–5″ (10–13 cm)	A_{22g}	Dark gray (2.5YR 4/0) silty clay with stains and spots of reddish-brown (5YR 5/4 and 4/3) occupying about 20% of the horizon; moderate, fine blocky to massive; slightly sticky; pH 7.0; abrupt, irregular boundary.
5″–10″ (13–25 cm)	B_{tg}	Dark gray (5YR 4/1) silty clay with reddish-brown (5YR 4/4) streaks and spots occupying about 10% of the horizon; moderate, medium, angular blocky; slightly sticky; pH 7.5.
10″–17″ (25–43 cm)	C_{1g}	Weak red (10R 4/2) slightly mottled silty clay to clay; weak, very fine angular blocky; slightly sticky; ground water stood at 14″ on June 13, 1961; pH 8.0; gradual, wavy boundary.
17″–30″ (43–76 cm)	C_2	Weak red (10R 4/2) clay with specks of slightly paler lime (10R 5/2); massive to weak, fine angular blocky; slightly pH 5.5; abrupt, smooth boundary.
30″–50″ (76–127 cm)	C_3	Weak red (10R 4/2) clay; massive; highly calcareous.

Type location: S.E.¼N.W.¼ Sec. 20, T.48N., R.40W., Ontonagon County, Michigan. Series established: Iosco County, Michigan, 1956. Source of name: Village in Chippewa County, Michigan.

SAUGATUCK SERIES (No. 15 on the soil map)

General Description. The Saugatuck series includes imperfectly drained acid sands with a cemented subsoil layer or hardpan.

Detailed Description. This series includes soils formed under conditions of imperfect drainage from acid glacio-fluvial and -lacustrine sands. "Saturated" sand lies at a depth of about 24″ in July and August, usually, and the water-table stands during those months at a depth of about 36″. The original vegetation included black spruce, tamarack, white pine, hemlock, red maple. The soils are classified as Groundwater Podzols. The subsoil (B_{hir}) begins at a depth of about 15″ and continues downward another 15″ with maximum contents of about 6% clay, 6% silt, and 10% organic matter. Above the B horizon is a pale sand layer (A_2 horizon) containing about 3% clay and 3% silt, with 1% organic matter. The B_{hir} is cemented and is called an "Ortstein." The A_2 is called a "Bleicherde." Both of these horizons appear irregular in cross-section, with tongues extending downward several inches. Soil types include sands and loamy sands. In Florence County there are some Saugatuck-like loams associated with Pence soils. Slope gradients are less than 2%, except for local steeper slopes caused by tipping over of trees. Associated soils are Hiawatha, Au Train, Vilas, peat. This soil was observed in the N.W.¼ Sec. 6, T.40N., R.15E. A profile description follows:

6″–4″ (15–10 cm)	A_{00}	Leaf litter.
4″–0″ (10–0 cm)	A_0	Humus.
0″–2″ (0–5 cm)	A_1	Black (10YR 2/1) sand, with light gray quartz grains abundant; weak, medium granular to single grain; loose; pH 4.5; about 20% organic matter; abrupt, wavy boundary.

2″–15″ (5–38 cm)	A_2	Light gray (10YR 7/1) sand; single grain; loose; pH 4.0; abrupt, irregular boundary.
15″–30″ (38–76 cm)	B_{hir}	Very dark brown (10YR 2/2) in the upper 4 inches, dark brown (7.5YR 4/2) in the next 4 inches, and yellowish-brown (10YR 5/6) below that; sand; cemented hard above, less thoroughly below; pH 4.5 above, 5.0 below; clear irregular boundary.
30″–40″ (76–102 cm)	C_g	Light gray (2.5YR 7/2) sand, mottled pale yellow (7/4); single grain; loose; pH 5.0.

Type location: Allegan County, Michigan. Source of name: Town in Allegan County, Michigan. Series established: Allegan County, Michigan, 1901.

SPALDING SERIES (Nos. 15 and 17 on the soil map)

General Description. The Spalding series includes deep acid woody and fibrous peat with forest cover.

Detailed Description. This series includes organic soils formed from acid woody and fibrous organic materials more than 42″ deep. Original vegetation, which continues today on most bodies of these soils, is dominantly black spruce and tamarack forest, with a ground cover of leatherleaf. These soils are classified as Bog soils. Organic matter content usually ranges above 70%. Slopes are usually less than 2% in gradient. Microrelief of the bog surface may be very irregular because of uneven distribution of tree roots, and as a result of treefall. Associated soils are the Greenwood and Dawson. This soil was observed in the S.W.¼S.W.¼ Sec. 28, T.40N., R.15E. A profile description follows:

5″–3″ (13–8 cm)	A_{oo_1}	Forest litter.
3″–0″ (8–0 cm)	A_{oo_2}	Spongy moss (largely sphagnum).
0″–2″ (0–5 cm)	0_1	Dark grayish-brown (10YR 4/2) woody peat, massive; soft and friable; pH 4.0; clear, wavy boundary.
2″–15″ (5–38 cm)	0_2	Dark reddish-brown (5YR 3/4) woody and fibrous peat; massive; pH 4.0; gradual, wavy boundary.
15″–30″ (38–76 cm)	0_3	Yellowish-brown (10YR 5/4–5/8) woody and fibrous and mossy peat; pH 4.0; gradual, wavy boundary.

Figure 26. View of Silver Dollar Lake, S.E.¼ Sec. 20, T.40N., R.16E., showing encroachment on the lake of Spalding peat (tree-covered flat) and Greenwood peat (treeless flat). Forested hilly Emmert soils surround this lake and bog.

30″–60″ (76–152 cm)	O_4	Yellowish-brown (10YR 5/6–5/8) woody and fibrous peat; massive; weak, coarse platy in lower part; pH 4.5.
60″–63″ (152–160 cm)	D_g	Gray (2.5Y 6/0–6/2) loam; pH 5.0.

Type location: N.W.¼N.W.¼ Sec. 20, T.14N., R.14E., Sanilac County, Michigan. Series established: Chippewa County, Michigan, 1927. Source of name: Village in Menominee County, Michigan.

STAMBAUGH SERIES (Nos. 2, 6, 7, 8, 9, 13 and 14 on the soil map)

General Description. The Stambaugh series includes moderately deep acid soils of medium texture underlain by sand and gravel.

Detailed Description. This series includes soils developed under conditions of good natural drainage or aeration from 24″ to 42″ of silty material overlying acid sand and gravel of glacio-fluvial origin. In a north-south belt in Range 16 in Florence County, there is a stony, cobbly loam, till-like layer 6″ to 24″ thick between the silty solum and the underlying sand and gravel (see Figures 2 and 14). Wherever the till-like layer was thicker than 2′, the soil was classified as Goodman. The original vegetation included hemlock, balsam fir, red and white pine, yellow birch, hard maple. These soils are classified as medial Podzols overlying Gray-Brown Podzolic-like profiles. The Podzol B horizon begins at a depth of about 4″ and continues downward about a foot, with maximum contents of about 15% clay, 60% silt, and 4% organic matter. Overlying it is a pale horizon (A_2) with somewhat less organic matter. Under the Podzol solum is a pale horizon (A'_{2x}) containing about 12% clay, 65% silt and 0.5% organic matter, underlain by a textural B horizon (B'_{tx}) containing about 20% clay, 55% silt, and 0.4% organic matter. See Tables XVI and XVII for more information. Slope gradients range from 1% to 10%. Associated soils include Pence, Fence, Goodman. Deep, normal, and shallow phases of Stambaugh were observed in the S.E. corner of Sec. 11, T.40N., R.15E. A typical soil profile description follows:

2″–1″ (5–2.5 cm)	A_{00}	Leaf and needle litter with abrupt lower boundary.
1″–0″ (2.5–0 cm)	A_0	Dark reddish-brown (5YR 2/2) humus; pH 6.5; abrupt, smooth boundary.
0″–½″ (0–1.3 cm)	A_1	Black (5YR 2/1–2/2) silty muck to silt loam; weak, medium granular; soft to very friable; bits of charcoal present; pH 5.5; abrupt, wavy boundary.
½″–5″ (1.3–13 cm)	A_2	Pinkish-gray (7.5YR 6/2) silt loam; weak moderate to thin platy; very friable; pH 5.5; abrupt, wavy boundary.
5″–7½″ (13–19 cm)	B_{hir}	Dark reddish-brown (5YR 3/3–4/3) silt loam; weak moderate subangular blocky to coarse granular; very friable; soft; pH 5.0; clear, wavy boundary.
7½″–10½″ (19–27 cm)	B_{ir}	Dark brown (7.5YR 4/4) silt loam; weak, moderate, subangular blocky to coarse granular; very friable; soft, pH 5.0; clear, wavy boundary.
10½″–18½″ (27–47 cm)	A'_{2x}	Dark brown (7.5–10YR 4/3) silt loam; moderate, thick platy; vesicular; hard; firm to friable; 1% gravel by volume; pH 5.0; there are a few fine remnants of B_{tx} showing as patches of reddish-brown (5YR 4/3); clear, wavy boundary.
18½″–30″ (47–76 cm)	B'_{tx}	Reddish-brown (5YR 4/3) silt loam; moderate, medium, angular blocky to platy; slightly hard; vesicular; friable when crushed; 5% gravel by volume; pH 5.0; abrupt, wavy boundary.

30″–30½″ (76–78 cm)	B_{3tx}	Yellowish-brown (10YR 5/4–5/3) loam; massive; slightly hard; friable; many fine clay skins are present; 1% gravel by volume; pH 5.5; abrupt, wavy boundary.
30½″–33″ (78–84 cm)	D_1	Brown to reddish-brown (7.5YR 5/4, 5/6; 5YR 4/3) medium sand; stratified; loose; no gravel or cobbles; pH 6.2; abrupt wavy boundary.
33″–36″ (84–92 cm)	D_2	Dark brown (7.5YR 5/4–4/2) coarse sand and gravel; 50% gravel by volume; stratified; loose; pH 6.2.

Type location: Marquette County, Michigan. Series established: Iron County, Michigan, 1930. Source of name: Town of Stambaugh, southern Iron County, Michigan.

SUPERIOR SERIES (No. 5 on the soil map)

General Description. The Superior series includes shallow to moderately deep sands and loams over clay which may be limey at depths of 2′ to 3′.

Detailed Description. This series includes soils developed from less than 18″ of sandy or silty material over reddish-brown calcareous or dolomitic clay and silty clay in the normal phase, and 18″ to 36″ of this material over clay in the deep phase. Natural drainage and aeration conditions have been good. Original vegetation included hemlock, balsam fir, red and white pine. These soils are classified as medial Podzols over Gray Wooded profiles. The presence of clay skins in the clayey substratum is evidence of B horizon development in the Gray Wooded solum. The Podzol B begins at a depth of about 4″ and continues downward about 6″. It has maximum contents of about 16% clay, 70% silt, and 4% organic matter. It is overlain by a pale gray horizon (A_2) and dark surface layer (A_1). Below this Podzol solum is a Gray Wooded solum consisting of a light reddish-brown silt loam A'_{2x} which tongues down into a reddish-brown silty clay B'_{tx} horizon containing about 42% clay, 45% silt, and 0.2% organic matter. See Table XVII for more information. Slope gradients range from 1% to 12%. Associated soils are Hibbing, Wakefield, Zim, Tromald. This soil was observed in the N.E.¼S.E.¼ Sec. 9, T.39N., R.18E. A soil profile description follows:

1″–½″ (2.5–1.3 cm)	A_{00}	Leaf litter.
½″–0″ (1.3–0 cm)	A_0	Humus.
0″–2″ (0–5 cm)	A_1	Black (5YR 2/1) silt loam; weak; medium granular; friable; pH 5.7; abrupt, irregular boundary.
2″–3½″ (5–9 cm)	A_2	Gray (5YR 6/1) silt loam; massive to weak medium platy; friable; pH 5.7; abrupt, wavy boundary.
3½″–10″ (9–25 cm)	B_{hir}	Dark reddish-brown (5YR 3/4–4/4) silt loam; weak, medium granular friable; pH 5.3; abrupt, wavy boundary.
10″–12″ (25–31 cm)	A_{2x}	Reddish-brown (5YR 5/3) to light reddish-brown (5YR 6/3) silt loam; moderate, medium subangular blocky; firm to friable; pH 5.3; abrupt, wavy boundary.
12″–14″ (31–36 cm)	A'_{2x}–B'_{tx}	Reddish-brown (5YR 4/4) loam, with dark reddish-gray (5YR 4/2–5/3) coatings on the peds; massive to weak, coarse platy; vesicular; pH 5.3; abrupt, wavy boundary.
14″–22″ (36–56 cm)	B'_{tx}	Reddish-brown (2.5YR 4/4) silty clay; strong, medium, subangular blocky; plastic; pH 5.3; above to 7.0 below; clear, wavy boundary.

22″–40″ (56–102 cm)	C	Reddish-brown (2.5YR 4/4–5/4) silty clay; strong, medium, subangular blocky; dolomitic.

Type location: N.E.¼S.E.¼ Sec. 10, T.50N., R.6W., Bayfield County, Wisconsin. Series established: Munsing Area, Alger County, Michigan, 1904. Source of name: City in Douglas County, Wisconsin.

TIPLER SERIES (No. 14 on the soil map)

General Description. The Tipler series includes imperfectly drained, deep acid fine sands.

Detailed Description. This series includes soils formed under conditions of imperfect soil drainage or aeration from 18″ to 42″ of silts and very fine sands overlying acid brown coarse silts, very fine sand, fine sand, and sand lacustrine deposits. The original vegetation included balsam fir, white and red pine, hemlock, hard maple, and yellow birch. These soils are classified as imperfectly drained medial Podzols, and may exhibit a weakly developed textural B below the Podzol profile. The subsoil (B horizons) begins at a depth of about 6″ and continues downward about 2′ with maximum contents of about 18% clay, 55% silt, and 2% organic matter. Above the B horizon is a pale layer (A_{2g} horizon) containing about the same amounts of silt and clay with slightly less organic matter than the horizon below. Slope gradients range from 0% to 3%. Associated soils are Fence, Cable, Goodman, peat. This soil was observed in the N.W.¼N.E.¼ Sec. 26, T.40N., R.15E. A soil profile description follows:

2″–½″ (5–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Black humus.
0″–½″ (0–1.3 cm)	A_1	Black (5YR 2/1) silt loam; weak, very fine granular; friable; pH 5.5; abrupt, smooth boundary
½″–5½″ (1.3–14 cm)	A_{2g}	Grayish-brown to light grayish-brown (10YR 5/2–6/2) silt loam, mottled strong brown (7.5YR 4/4) coarse silt loam; vesicular; moderate fine subangular blocky and moderate, medium platy; friable; numerous soft iron concretions present; pH 5.5; clear, smooth boundary.
5½″–10″ (14–25 cm)	B_{hirg}	Dark brown (10YR 4/3), mottled dark reddish-brown (5YR 3/3), silt loam; weak fine platy, friable; pH 5.5; clear, wavy boundary.
10″–15″ (25–38 cm)	A'_{2gx}	Brown (7.5YR 5/3), mottled lighter and darker browns (7.5YR 5/4, 3/2), coarse silt loam; vesicular; moderate, coarse platy; firm, but shatters suddenly under pressure between the fingers; pH 5.5; clear, wavy boundary.
15″–25″ (25–64 cm)	A'_{2x} & B'_{tx}	Interfingering of these two horizons.
25″–32″ (64–81 cm)	B'_{tgx}	Dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6), mottled reddish-brown (5YR 4/4), coarse silt loam; reddish-brown (5YR 5/3) clay films and light colored silty coatings are present; weak, coarse platy to weak, fine, subangular blocky; friable; pH 5.5; clear, wavy boundary.
32″–60″ (81–152 cm)	C_g	Dark yellowish-brown (10YR 4/4), mottled with dark brown (7.5YR 4/4), silts and fine sands; stratified; compact, friable; pH 5.5.

Type location: N.W. corner Sec. 16, T.35N., R.3E., Price County, Wisconsin. Series proposed: Florence County, Wisconsin, 1959. Source of name: Small village in Florence County, Wisconsin.

TROMALD SERIES (No. 15 on the soil map)

General Description. The Tromald series includes wet, deep clay soils containing a few stones and having a limey clay substratum at depths of 2′ to 3′.

Detailed Description. This series includes soils developed from reddish-brown, neutral to dolomitic or calcareous clay or silty clay glacial till, under poor natural drainage and aeration conditions. Natural vegetation includes spruce, cedar, balsam fir, hemlock, elm, ash, birch, hard maple. These soils are classified as Low Humic-Gley soils. The subsoil (BG) begins at a depth of about 5″ and continues downward another 5″, with contents of about 55% clay, 35% silt, and 0.5% organic matter. Above the subsoil is a silt loam to silty clay loam horizon (A_1). Slope gradients are less than 2%. Associated soils are Hibbing, Zim, Ontonagon, Pickford, Bergland. This soil was observed near the center of Sec. 23, T.38N., R.18E. A profile description follows:

1½″–0″ (4–0 cm)	A_0	Brown to dark brown, (7.5YR 4/2–4/4) fibrous mat of decaying plant stems and leaves; matted and quite resistant to cutting or breaking; abrupt, smooth boundary; pH 5.4.
0″–2½″ (0–6 cm)	A_{11}	Black (5YR 2/1) mucky silt loam; finely granular; not sticky; slightly plastic; very high in organic matter which imparts a smooth slick feeling; many fine roots; abrupt, smooth boundary; pH 5.5 There is a ¼″–½″ wide channel or crack running from the surface into the C horizon which is filled with roots and this material.
2½″–4″ (6–10 cm)	A_{12}	Very dark gray (10YR 3/1), with a few, medium, faint mottles of reddish-brown (2.5YR 4/4), silty clay loam; medium, moderately developed, subangular blocky; sticky and plastic; fine roots; abrupt wavy boundary; pH 5.7.
4″–10½″ (10–27 cm)	BG	Weak red to dark reddish-gray (2.5YR 4/2–3/1), mottled reddish-brown (2.5YR 4/4), strong brown to yellowish-red (7.5YR to 5YR 5/8) silty clay; ribbons well; sticky and plastic; coarse, subangular blocky to prismatic; thin clay skins on ped faces; clear, smooth boundary; pH 5.8.
10½″–20″ (27–51 cm)	C_1	Reddish-brown (5YR 4/4), with a few faint mottles of dark reddish-gray (5YR 4/2) sandy clay loam; coarse prismatic to massive; slightly sticky and plastic; some channels and mixing of overlying material; pH 6.0.
20″–48″ (51–122 cm)	C_2	Dark red (2.5YR 3/6) and reddish-brown (5YR 4/3) silty clay loam to silty clay, with some small specks of grayish-brown (10YR 5/2); sticky; plastic; effervesces at 33″ or 84 cm; pH 6.7 to 7.5 above 33″ to calcareous below that depth.

Type location: N.W.¼S.W.¼ Sec. 35, T.45N., R.28W., Crow Wing County, Minnesota. Series established: Crow Wing, Minnesota, 1960. Source of name: Village in Crow Wing County, Minnesota.

UBLY SERIES (VARIANT) (Nos. 5 and 10 on the soil map)

General Description. The Ubly series includes acid, well drained loamy sands, moderately deep over heavy, somewhat stony loam, which is limey at depth of about 3′ to 6′.

Detailed Description. This series includes soils formed from 18″ to 42″ of sandy loam or loamy sand overlying reddish-brown (2.5YR–5YR 4/4) loam to clay material, which is acid to a depth of 3′ to 6′, at which depth it becomes calcareous. Natural drainage or aeration is good. The original vegetation included hemlock, balsam fir, yellow birch, hard maple. These soils are classified as minimal to medial Podzols overlying a weakly developed Gray Wooded-like sequence of A_2 and B_t horizons. The Podzol B horizon begins at a depth of about 4″ and continues downward about 20″ into a weak fragipan. In this B horizon maximum contents occur of about 14% clay, 52% silt, and 2% organic matter. Above this horizon is the pale A_2 of the Podzol. Below the Podzol solum is a lower pale layer (A'_{2x}) with about 12% clay, and 52% silt which tongues into an underlying, redder silty clay loam to clay subsoil (B'_{tx}). Slope gradients range from 2% to 10%. Associated soils are Ahmeek, Wakefield, Hibbing, Pence. This soil was observed in the N.W.¼N.W.¼ Sec. 2, T.39N., R.18E. A profile description follows:

1″–½″ (2.5–1.3 cm)	A_{oo}	Leaf litter.
½″–0″ (1.3–0 cm)	A_o	Humus, nearly black.
0″–2″ (0–5 cm)	A_1	Dark brown (7.5YR 3/2) silt loam; weak to moderate, fine, angular block; friable; pH 6.0; many fibrous roots; clear, smooth boundary.
2″–4″ (5–10 cm)	A_2	Reddish-gray (5YR 5/2) gritty silt loam; weak thin platy; very friable; pH 5.2; many fibrous roots; clear, smooth boundary.
4″–7″ (10–18 cm)	B_{hir}	Dark reddish-brown (5YR 3/4) gritty silt loam; weak, very fine subangular blocky to weak very fine crumb; very friable; pH 5.4; many fibrous roots; clear, wavy boundary.
7″–13″ (18–33 cm)	B_{ir}	Reddish-brown (5YR 4/4) gritty silt loam to very fine sandy loam; weak, very fine subangular blocky to weak very fine crumb; very friable; pH 5.5; fibrous roots common; clear, wavy boundary.
13″–17″ (33–43 cm)	B_{irx}	Reddish-brown (5YR 4/4) loam; weak thin platy to weak, medium, subangular blocky; pH 5.6; weakly cemented when moist, strongly cemented when dry; this is a fragipan layer; clear, wavy boundary.
17″–22″ (43–56 cm)	A'_{2x} & B'_{tx}	Dark reddish-brown (5YR 3/4) moderate, thin platy fine sandy loam tonguing downward into dark reddish-brown weak, medium to coarse, subangular blocky, slightly heavier fine sandy loam; weakly cemented when moist, but strongly cemented when dry, fragipan; pH 5.9; abrupt, wavy boundary.
22″–24″ (56–61 cm)	A'_{2x} & B'_{tx}	Reddish-gray (5YR 5/2), vesicular, moderate, thin platy very fine sandy loam to gritty silt loam fragipan tongues extending downward into reddish-brown (2.5YR 4/4) weak, medium, subangular blocky silty clay loam; pH 5.7; abrupt, irregular boundary.
24″–28″ (61–71 cm)	A'_{2x} & B'_t	Dark reddish-gray (5YR 4/2) slender tongues of fine sandy loam to gritty silt loam fragipan extending into reddish-brown (2.5YR 4/4) moderate, angular blocky, very firm silty clay loam; pH 5.5; abrupt, irregular boundary.
28″–48″ (71–122 cm)	B'_t	Reddish-brown (2.5YR 4/3) clay with slightly redder (2.5YR 4/4) clay films on the structural units; moderate, medium, angular blocky; very firm; pH 5.5 to 6.5 at the bottom of this horizon.

48″–50″ (122–127 cm)	C_1	Reddish-brown (2.5YR 4/3) clay loam; weak, coarse subangular and angular blocky; firm; pH 7.0 with spots of dolomitic till.

Type location: S.E.¼N.W.¼ Sec. 27, T.8N., R.4E., Shiawassee County, Michigan. Series proposed: Grand Traverse County, Michigan, 1958. Source of name: Village in Huron County, Michigan.

VILAS SERIES (Nos. 4, 5, 6, 9, 10, 11, 12, 13, 17 on the soil map)

General Description. The Vilas series includes deep acid sands with a soft, brown subsoil at a depth of about 6″.

Detailed Description. This series includes very droughty soils developed from deep acid sands of glacial or glacio-fluvial origin. Original vegetation included jack pine, red and white pine, hemlock, and northern hardwoods. These soils are classified as minimal Podzols. Where the upper horizon is disturbed, as by animals, or by fire and wind erosion, the Vilas is not easily distinguished from the Omega. The subsoil (B_{hir}) begins at a depth of about 3″ and continues downward about 10″ with maximum contents of about 6% clay, 6% silt, and 2% organic matter. Above the B horizon is a bleached layer (A_2 horizon) with approximately the same contents of clay, silt, and organic matter as the horizon below. A coherent, firm horizon may occur between the B_{hir} and C. Slope gradients range from 0% to 20%. Soil types include sand, fine sand, loamy fine sand, and limited areas of sandy loam. Associated soils are Crivitz, Pence, Hiawatha. In Florence County a soil with a sandy loam texture in the upper 10″ of the profile is associated with the Vilas soils. See Table XVII for further data. The following description was taken in the S.E.¼N.W.¼ Sec. 19, T.38N., R.16E. A soil profile description follows:

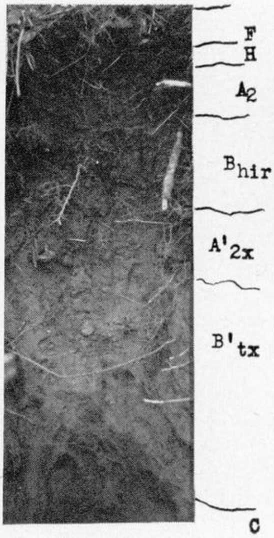
1″–¼″ (2.5–.7 cm)	A_{oo}	Leaf litter.
¼″–0″ (.7–0 cm)	A_o	Dark brown (7.5YR 3/2) humus.
0″–½″ (0–1.3 cm)	A_1	Black (10YR 2/1) loamy sand; weak, medium granular; loose; pH 5.5; abrupt, wavy boundary.
½″–3″ (1.3–8 cm)	A_2	Brown (7.5YR 4/2–5/2) loamy sand; light colored quartz grains evident; single grain to weak medium granular; loose; pH 5.0; abrupt, wavy boundary.
3″–5″ (8–13 cm)	B_{hir1}	Dark brown (7.5YR 3/2–4/4) sand; single grain; loose; small cemented lumps of sand are rare; pH 4.7; abrupt, wavy boundary.
5″–12″ (13–31 cm)	B_{hir2}	Yellowish-red (5YR 4/6) sand; single grain to very weak medium granular; loose to very slightly friable; loose; pH 4.7; abrupt, wavy boundary.
12″–30″ (31–76 cm)	C	Yellowish-brown (10YR 5/6) sand; single grain; loose; pH 5.5.

Type location: Sec. 26, T.48N., R.7W., Bayfield County, Wisconsin. Series established: Iron County, Michigan, 1930. Source of name: Vilas County, Wisconsin.

WAKEFIELD SERIES (Nos. 2, 3, 4, 5, on the soil map)

General Description. The Wakefield series includes well drained, acid, shallow fine loams over acid, heavy loam which is somewhat stony.

Detailed Description. This series includes soils developed from less than 18″ of silty material over acid, reddish-brown loam to clay loam glacial till. Natural drainage or aeration conditions have been good. The original vegetation included hemlock, balsam fir, yellow birch, hard maple. These soils are classified as medial Podzols. The subsoil (B horizon) begins at a depth of about 3″ and continues downward



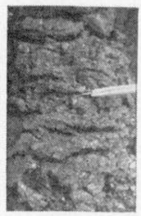


Figure 27. This is Wakefield loam, developed in about 18 inches of gritty silt loam over heavy loam to clay loam glacial till. The F layer is the fermenting leaf litter layer; the H layer is the humus horizon; the A_2 is a paler, bleached horizon; the B_{hir} is the dark brown Podzol B horizon; the A'_{2x} is a pale fragian; the B'_{tx} is a reddish-brown, somewhat clay-enriched fragipan; the C horizon is glacial till, a close-up view of which is shown in the small inset picture below the landscape. This till is coarsely platy horizontally in the direction of the 2-inch-long knife handle shown. The landscape shows a fine crop of oats in the foreground and forest in the background, on this soil.

about 10″. Above the B horizon is a pale horizon, the A_2 of the Podzol; and below the B is another pale horizon, the fragipan or second A_2. This horizon, designated the A'_{2x}, and the textural B horizon below it, comprise a weakly developed Gray-Brown Podzolic-like solum. The glacial till exhibits a moderate, medium platy structure to a considerable depth. Slope gradients range from 1% to 12%. See Tables XVI and XVII for additional data. Associated soils are Ahmeek (see Figure 7), Iron River, and Goodman, along with inclusions in the Goodman of bodies of deep (18″–42″) silty Podzols over loam to clay loam glacial till. This soil was observed in the S.W.¼N.E.¼ Sec. 29, T.40N., R.17E. A profile description follows:

1″–½″ (2.5–1.3 cm)	A_{00}	Leaf and needle litter.
½″–0″ (1.3–0 cm)	A_0	Humus.
0″–1″ (0–2.5 cm)	A_1	Dark reddish-brown (5YR 3/2) to dark brown (7.5YR 4/2) loam; weak, fine granular; friable; bleached sand grains common; pH 5.3; abrupt, smooth boundary.
1″–3″ (2.5–8 cm)	A_2	Brown (7.5YR 5/2–5/4) loam; strong, thin platy; very friable; pH 5.3; abrupt, wavy boundary.
3″–7″ (8–18 cm)	B_{hir}	Reddish-brown (5YR 4/4) to dark brown (7.5YR 4/4) gritty silt loam to loam; weak, fine to medium, subangular blocky; friable; pH 5.1; clear, wavy boundary.
7″–11″ (18–28 cm)	B_{ir}	Dark brown (7.5YR 4/4) gritty silt loam to loam; weak, fine to medium, subangular blocky; friable; pH 5.4; clear, wavy boundary.

11″–15″ (28–38 cm)	A'_{2x}	Dark brown (7.5YR 4/3) gritty silt loam to loam; moderate to strong, medium platy, with more than 50% overlap of plates; length of plates is three times the thickness; hard, firm fragipan; many fibrous roots at the upper boundary of this horizon; pH 5.6; abrupt, irregular boundary.
15″–19″ (38–48 cm)	A'_{2x} & B'_{tx}	Tongues of light grayish-brown (10YR 6/2–5/2) weak to moderate, medium platy, gritty silt loam to loam; fragipan penetrates downward into reddish-brown (5YR 4/4–3/4) weak, coarse prismatic, slightly finer textured fragipan; some plates approach squamose; hard and firm; pH 5.9; abrupt, irregular boundary.
19″–28″ (48–71 cm)	A'_{2x} & B'_{tx}	Same colors as above; weak, platy, gritty silt loam tonguing down into weak to moderate, medium, angular blocky and prismatic clay loam; hard, firm fragipan layer; weak vertical cleavage is present on either side of the gritty tongues of lighter colored fragipan; pH 6.0; clear, wavy boundary.
28″–40″ (71–102 cm)	B'_{tx}	Reddish-brown (5YR–2.5YR 4/3) silt loam to clay loam; moderate, medium to coarse, angular blocky and moderate, medium to coarse platy; hard fragipan; some thin clay films are present on the surfaces of structural units; pH 5.9; clear, wavy boundary.
40″–60″ (102–152 cm)	B'_t	Reddish-brown (2.5YR 4/4) stony clay loam to loam; moderate, very coarse platy; firm; pH 5.5 above to 6.5 below.

Type location: Gogebic County, Michigan. Series proposed: Gogebic County, Michigan, 1952. Source of name: Gogebic County, Michigan.

ZIM SERIES (Nos. 5, 15, and 16 on the soil map)

General Description. The Zim series includes imperfectly drained deep clay soils which are limey at a depth of about 2′ or 3′.

Detailed Description. This series includes soils formed under imperfect natural drainage or aeration conditions from dolomitic or calcareous silty clay glacial till. Less than 8″ of silty deposit occurs on these soils. Original vegetation included white and red pine, balsam fir, hemlock, spruce, yellow birch, and hard maple. These soils are classified as imperfectly drained, medial Podzols, grading to Gray Wooded soils, the chief feature of which is the clay-rich B horizon. The subsoil (B_t) begins at a depth of about one foot and continues downward about 20″, with maximum contents of about 45% clay, 50% silt, and 1% organic matter. Above the B horizon is a somewhat paler layer (A_2 horizon) with maximum contents of about 25% clay, 70% silt, and 1% organic matter. This horizon tongues downward into the B and surroundings some isolated fragments of the upper B horizon. Slope gradients are less than 2%. Associated soils are Hibbing, Tromald, Ontonagon, Rudyard. This soil was observed in the S.W.¼ Sec. 3, T.38N., R.18E. A soil profile description follows:

3″–2″ (8–5 cm)	A_{oo}	Leaf litter.
2″–0″ (5–0 cm)	A_o	Black, peaty humus layer.
0″–4″ (0–10 cm)	A_1	Very dark brown (10YR 2/2) silt loam; moderate, fine, subangular blocky; friable; pH 5.3; clear, wavy boundary.
4″–7″ (10–18 cm)	A_2	Pale brown (10YR 6/3–6/2), mottled yellowish- and reddish-browns (10YR and 5YR 5/4) silt loam; with common, fine, distinct to prominent mottles; weak to moderate thin platy; very friable; pH 5.4; abrupt, irregular boundary.

7″–11″ (18–28 cm)	A_2 & B_t	Reddish-gray (5YR 5/2) thick tongues of friable, mottled A_2 extending down into the moderate to strong, medium, angular blocky, firm, reddish-brown (5YR 4/3) silty clay loam B_t, some isolated remnants of which are embedded in the lower A_2; pH 6.0; clear, irregular boundary.
11″–30″ (28–76 cm)	B_t	Reddish-gray (5YR 4/3) silty clay, mottled strong brown (7.5YR 5/6), fine to medium, angular blocky; very firm; this is penetrated by a few tongues of gray (5YR 5/1–4/1) A_2 to a depth of 18 inches; pH 6.2 above to 6.5 below; clear, smooth boundary.
30″–34″ (76–86 cm)	B_3	Reddish-brown (2.5YR 4/4), mottled brown (7.5YR 5/4), and clay-skin coated silty clay; strong, fine, angular blocky; very firm; pH 6.7; clear, smooth boundary.
34″–40″ (85–102 cm)	C	Reddish-brown (2.5YR 5/4) silty clay; massive to moderate, coarse, angular blocky; very firm; stones present; dolomitic or calcareous.

Type location: Center N.W.¼ Sec. 2, T.46N., R.28W. Series established: Crow Wing County, Minnesota, 1960. Source of name: Small village, Section 27, T.56N., R.18W., St. Louis County, Minnesota.

VII. SOIL GEOGRAPHY

Introduction

The soil types of Florence County which have been described in detail on preceding pages occur as soil bodies in the landscapes. The land surface of the county is a mosaic of soil bodies in which can be seen distinct patterns or units, which we call soil associations or "soil communities." In Figure 6, for example, the Iron River loams constitute one unit of the landscape, and peat soils another unit, distinct from the Pence and Padus loams.

On the soil map 17 soil associations are shown. This chapter of the report briefly describes these natural geographic soil groupings, and also presents soil keys (Figures 28 and 35) and diagrams (Figures 29, 31, 36, 41, 44, and 47) to indicate the relationships of individual soil types to the landscapes in which they occur.

A soil community or association consists of soil bodies representing usually less than a dozen soil types. The term "association" indicates that the soils are associated on the landscape. The term "community" indicates that the combination of soils in a given portion of the landscape has unique dynamic characteristics with respect to the manner in which it handles precipitation and solar radiation, the kinds of plants and animals it will support, and the quality of products it will yield. For example, 50 acres of level, productive Fence and Stambaugh silt loams (Figure 44) in the midst of 150 acres of hilly Vilas and Randville loamy sands could support a dairy farm, but 200 acres of hilly Vilas and Randville loamy sands would not.

Soil unit number one on the soil map, Goodman and associated soils, nearly level to undulating, is illustrated in the central portion of Figure 29. All five components of this association (see Table XIV) are illustrated in the figure. Separation from Goodman soils (numbers 1 and 2) of peat and

GENERALIZED SOIL KEY NO. 1 FOR USE IN LANDSCAPES OF FLORENCE COUNTY, WISCONSIN

(Note: A soil key for your farm will be simpler. Your agricultural leader can help you prepare a soil key for your vicinity.)

|← LAY OF THE LAND →|← SOIL PROFILE →|← SOIL NAME →|

SOILS OF SOIL ASSOCIATIONS 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

- Soils above bogs and streams and therefore not flooded with water nor wet permanently. Soils nearly level to hilly
  - Sandy and gravelly soils
    - Shallow, gravelly, very stony soils underlain by gravel and sand .... EMMERT
    - Deep sand or loamy sand surface soil overlying sand at 6 to 24 inches
      - "B" horizon is brown (7.5 YR-5 YR 4/4) underlying very dark "A_p" or "A_1"; one-inch thick "A_2" may be present .... OMEGA
      - "B" horizon is reddish-brown (5 YR 4/4), 2-4 inches thick, underlying "A_p" or 1-3-inch "A_2" (7.5 YR 4/2) .... VILAS
      - "B" horizon is reddish-brown, 12-20 inches thick & slightly cemented, underlying an "A_p" or 3-7-inch "A_2" .... HIAWATHA
      - "B" horizon is dark reddish-brown (2.5 YR 2/4), 10-20 inches thick & cemented, underlying an "A_p" or "A_2" at 7 to 15 inches .... AU TRAIN
    - Loamy sand surface soil overlying sand at 18 to 42 inches .... "B" is brown to reddish-brown (5 YR 4/6) underlying an "A_p" or 1-3-inch "A_2" .... CRIVITZ
  - Loams and silt loams over loose sand and gravel
    - Sandy loam or loam is 12-24 inches deep .... PENCE
    - Loam or sandy loam is 24-42 inches deep .... PADUS
    - Silt loam is 18-42 inches deep .... STAMBAUGH
  - Silt loam over deep fine sand
    - Silt loam is 18" or more deep
      - No gray and rusty spots present .... FENCE
      - Gray and rusty spots present below 3" .... TIPLER
  - Silt loams and loams 18 to 42 inches thick over brown (7.5 YR) to reddish-brown (5 YR) stony sandy loam to clay loam
    - Surface silt loam is less than 24 inches deep; substratum is sandy loam till .... IRON RIVER
    - Surface silt loam is 24-42 inches deep; substratum is sandy loam to loam till with local bodies of clay loam till
      - Profile undisturbed by man shows "A_2" over "B_{hir}"
        - No gray and rusty spots present .... GOODMAN
        - Gray and rusty spots present below 3" .... GAASTRA
      - Profile undisturbed by man shows "A_1" over "B_{hir}" .... DEEP AHMEEK
    - Surface silt loam is less than 18 inches deep over loam to clay loam .... WAKFFIELD / AHMEEK
- Soils on low ground where water stands after rains or where soils are permanently wet.
  - Sandy soils over loose sand and gravel
    - Soils may be neutral or calcareous below 40 inches .... 3- to 4-inch black A_1 over mottled sand .... ROSCOMMON
    - Soil acid throughout
      - Whitish "A_2" 6 to 12 inches thick over dark rusty-spotted "B"; water table at shallow depth .... SAUGATUCK
      - 18"-30" sandy loam or loamy sand over acid loam, silt and sand layers; whitish "A_2" is 2 to 4 inches thick over rusty spotted "B" .... MOYE
  - Silt loams and loams over stony sandy loam
    - Silty or loamy layer less than 24 inches thick; dark gray "A_1" is less than 5 inches thick over mottled material .... CABLE
    - Silty or loamy layer is 24-42 inches thick
      - Nearly black "A_1" is more than 6 inches thick over mottled material .... ADOLPH
      - Dark gray "A_1" is less than 5 inches thick over mottled material .... AUBURNDALE
  - Organic soils of bogs; soil is more than 12 inches thick over sand, silt, loam or clay
    - Substratum is acid
      - More than 42 inches of mossy, fibrous peat; no forest cover .... GREENWOOD
      - More than 42 inches of woody, fibrous peat; forest cover present .... SPALDING
      - 12 to 42 inches of muck and peat .... LINWOOD
    - Substratum is marl .... 12 to 42 inches of neutral to calcareous muck .... EDWARDS
  - BRULE
  - Accumulated mineral soils of ravines and valleys .... ALLUVIAL SOILS
  - Accumulated organic soils of ravines and valleys .... PEATS AND MUCKS

Figure 28.

other wet soils into soil units numbered 15 and 16 on the soil map, and of Emmert and Vilas and associated soils, number 13, is based on contrasts between them.

A brief description of the 17 soil geographic and cartographic (map) units follows, numbered according to the legend of the colored soil map. Acreage estimates are given in Tables XIII and XIV.

DESCRIPTION OF CARTOGRAPHIC UNITS

Soils of the Glacial Till Upland

Five soil associations (cartographic units 1, 2, 3, 4, and 5) are included in this group. One or more major soils in each association is formed in glacial till or in a thin silty surfical deposit and glacial till. Soils of the glacial till upland are found throughout the county, but each association is largely restricted to certain townships. The total area occupied by these five soil associations is 80,028 acres or 25.2 per cent of the area of the county.

Soils formed from silty to loamy deposits overlying reddish-brown acid sandy loam to clay loam glacial drift, largely till

Four soil associations (cartographic units 1, 2, 3, and 4) are included in this group. One or more of the major soils in each association is formed in glacial till having a thin silty covering over it.

Cartographic or map units 1 and 2 differ chiefly as to topography. The first is nearly level to undulating and the second is rolling to hilly.

Soils of cartographic unit number 3 are developed from reddish-brown acid stony loam to clay loam till, associated with glacial deposits derived from iron formation bedrocks.

Cartographic unit number 4 includes soils formed from sandy loam and sand and gravel, with local surficial deposits of shallow silty material. This group of soils has an area of 70,486 acres or 22.2 per cent of the area of the county.

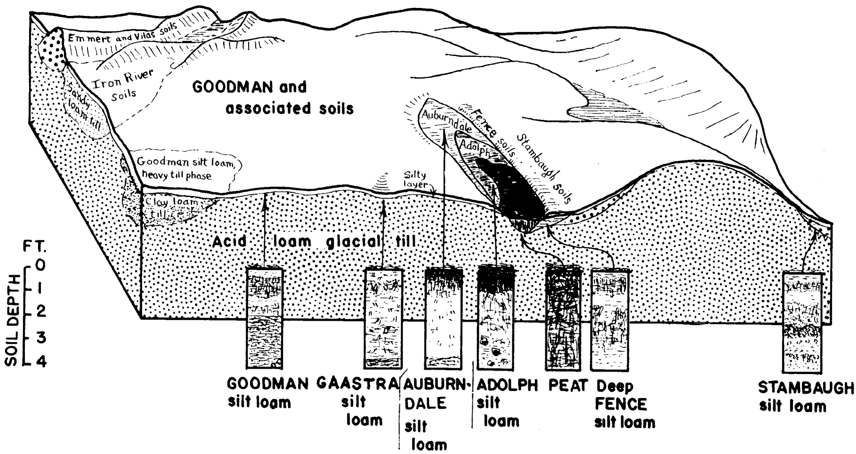


Figure 29. Generalized sketch showing relationships between some soils of northwestern Florence County, Wisconsin.

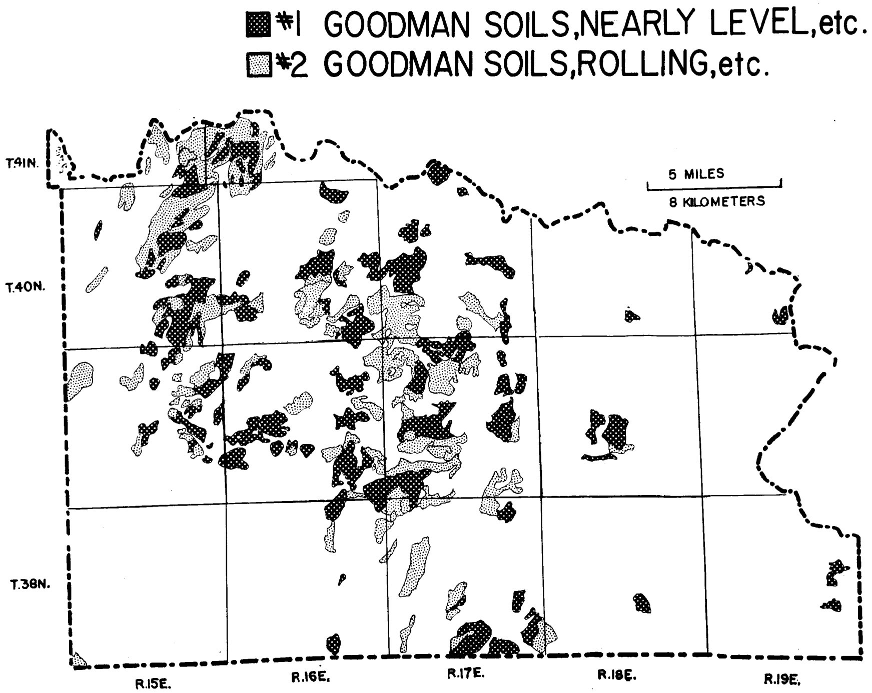


Figure 30. Geographic extents of units one and two of the colored soil map.

1. Goodman and associated soils, nearly level to undulating

Major soil—Goodman silt loam.

Minor soils—Auburndale, Stambaugh, Iron River and Gaastra silt loams, and Iron River loam.

Inclusions—About 10% of the area is underlain by a clay loam glacial till, and the soil has been referred to during this soil survey as "Goodman silt loam, heavy till phase." There are small bodies of peat and muck.

Distribution—In all townships except the southwestern most township, but concentrated in the western half of the county (Figure 30).

Total area—22,806 acres or 7.2% of the area of the county.

Description—Goodman soils, nearly level to undulating, occur, as indicated in the central portion of Figure 29, on an undulating (slope gradients 0% to 8%) till plain, which is interrupted locally by imperfectly drained depressions occupied by Gaastra and Auburndale silt loams. Bodies of buried sand and gravel outwash come close to the surface in places, and the silty soils at such places are called Stambaugh silt loam. In patches of sandy loam till Iron River soils have formed.

Goodman soils are silty to a depth of two or three feet over loam glacial till. The Stambaugh soils are similar, but are underlain by sand and gravel instead of loam till. Iron River soils include soils which are silty to a depth of two feet over sandy loam till, and soils which lack the silty covering altogether.

Gaastra and Auburndale are silty soils of depressions, and are imperfectly drained and poorly drained, respectively. If the depressions are sufficiently deep and wet, their centers may be occupied by peat and muck soils.

2. Goodman and associated soils, rolling to hilly

Major soil—Goodman silt loam.

Minor soils—Wakefield, Iron River, Stambaugh silt loams; Iron River, Padus and Pence loams.

Inclusions—Fence silt loams occur in narrow bodies between the drumlin-like hills and esker-like ridges of northwestern townships. There are bodies of peat and muck.

Distribution—Chiefly in the western two-thirds of the county (Figure 30).

Area—21,248 acres or 6.7% of the area of the county.

Description—Slope gradients of this soil association range from 8% to 30%. Some of the hills in northern and western Florence County are roughly parallel and drumlin-like in shape. They exhibit a northeast-southwest trend (Figure 25). The foot-slopes of these hills are characteristically covered by outwash sands and gravels which are covered with a silty deposit, which forms the parent material of the Stambaugh silt loams (Figure 29).

Goodman silt loams are silty to a depth of two or three feet over loam glacial till. Wakefield soils have less than 18 inches of silty soil over a loam to clay loam reddish-brown glacial till. The substratum of Iron River soils is a sandy loam glacial till, which may come clear to the surface, or be covered locally by as much as two feet of silty deposit.

Stambaugh soils resemble Goodman silt loams, but are underlain by outwash sand and gravel instead of glacial till. Padus loams are underlain at two to three feet by sand and gravel. Pence loams are only one to two feet deep over sand and gravel.

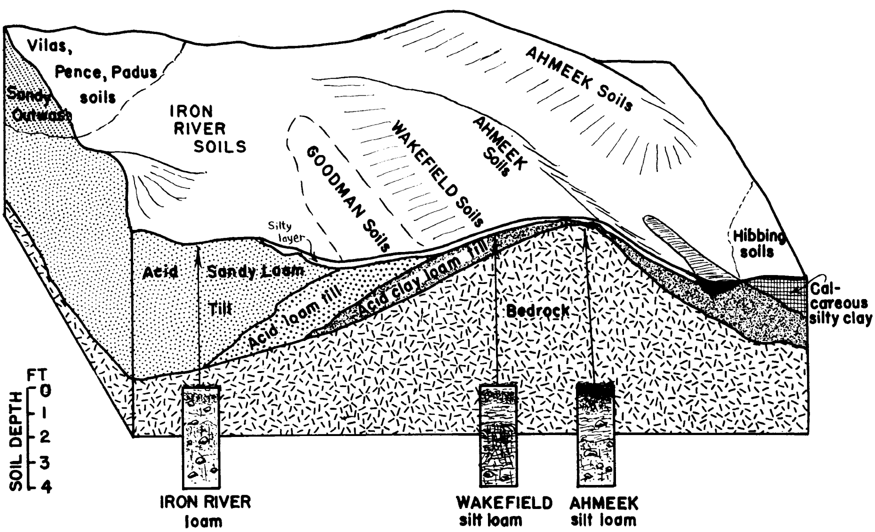


Figure 31. Generalized sketch showing relationships between some soils of north-central Florence County, Wisconsin.

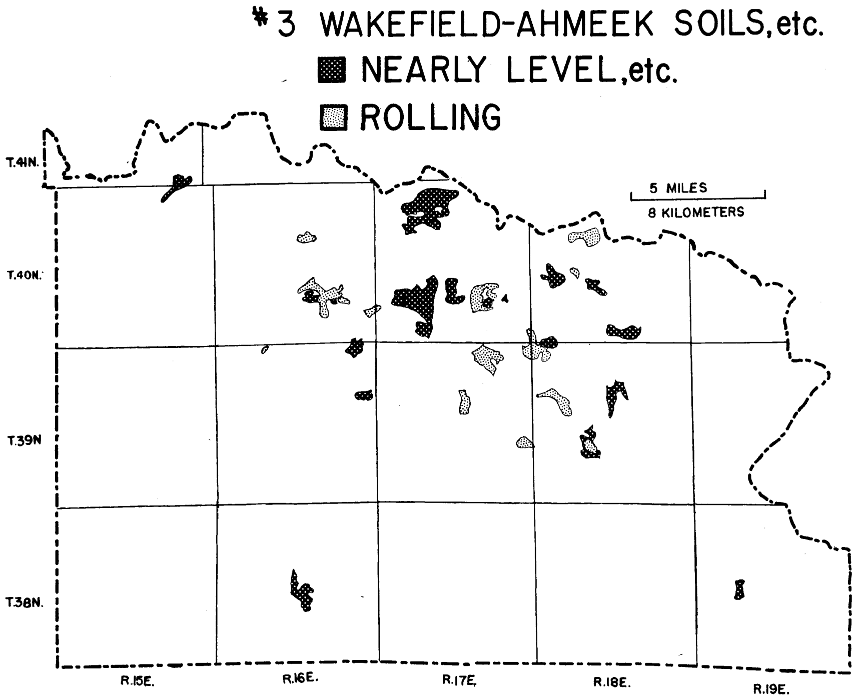


Figure 32. Geographic extent of unit number three of the colored soil map.

3. Wakefield, Ahmeek and associated soils, nearly level to hilly

Major soils—Wakefield and Ahmeek silt loams; Ahmeek loam, and stony loam.

Minor soils—Iron River silt loam; Iron River, Pence and Padus loams.

Inclusions—Outcrops of iron formation and related bedrocks occur locally. There is a deep silty phase of Ahmeek, with till occurring at depths of two to three feet. There are patches of Hibbing soils, and peats.

Distribution—These soils are found chiefly in northcentral and northeastern Florence County (Figure 32).

Area—7,761 acres or 2.4% of the area of the county.

Description—Slope gradients range from 0% to 30%. Ahmeek soils occur where glacial till is shallow over bedrock, and where a dark surface soil (A_1 horizon) is well developed. Wakefield soils occur over deeper till and do not exhibit a definite A_1 horizon. The impervious subsoil layer called the fragipan is usually well developed in Ahmeek soils. Both Wakefield and Ahmeek soils may be silty to a depth of 18 inches. There are bodies of Ahmeek stony loam, interspersed with boulders and bedrock outcrops.

Where patches of sandy loam glacial till occur, Iron River loams and sandy loams are found, and Iron River silt loams where a silt covering as much as 24 inches thick may occur.

Over bodies of outwash sand and gravel, Padus loams are found where the coarse material lies at a depth of two to three feet, and Pence soils occur where the sand and gravel is encountered at a depth of one to two feet.

4. Iron River, Pence and associated soils, nearly level to hilly

Major soils—Iron River and Pence loams and sandy loams.

Minor soils—Goodman, Hibbing, Wakefield silt loams; Padus loam; Randville loamy fine sand; Vilas and Hiawatha loamy sands.

Inclusions—Iron River silt loam; bedrock outcrops (Figure 22). A Hiawatha-like sandy soil occurs in the N.W.¼ Sec. 14, T.38N., R.19E., underlain at a depth of about two feet by a bouldery loam till.

Distribution—Chiefly in a north-south belt in east-central Florence County, but also found in townships to the east (Figure 33).

Area—18,671 acres or 5.9% of the area of the county.

Description—Slope gradients range from 0% to 30%. Some hills are small and have abrupt slopes, as in sections 5 and 6, T.38N., R.19E. (Figure 41), while others are broad (Figure 31). The glacial drift substratum is largely acid sandy loam till, usually stony, with inclusions of stratified sand and gravel.

Iron River and Pence soils are similar, but are underlain, respectively, by sandy loam stony glacial till, and outwash sand and gravel.

Goodman silt loams occur where two or three feet of silty covering overlies sandy loam to loam glacial till. Wakefield silt loam is about 18 inches deep to loam till.

Padus loam is two to three feet deep over sand and gravel.

Vilas and Hiawatha loamy sands occur over deep, acid sand, at depths of about one foot and three feet, respectively.

Hibbing soils are found where reddish-brown calcareous silty clay to clay comes to the surface, or within eight inches, under a silty covering.

Randville loamy fine sand is found in acid stratified sands and fine sands.

Soils formed from calcareous, reddish-brown clay loam and silty clay loam glacial drift, largely till, with local sandy covering

A single soil association, number 5, occurs in this group.

5. Hibbing, Ubly and associated soils, neary level to rolling

Major soils—Hibbing silt loam, silty clay loam; Ubly (variant) loam and sandy loam.

Minor soils—Manistee, Menominee, Hiawatha, and Vilas loamy sand; Ontonagon silty clay loam; Wakefield and Goodman silt loams; Zim and Rudyard silty clay to loam soils.

Inclusions—Tromald, Zim, and Bergland silty clays. Some peat and muck bodies.

Area—9,542 acres or 3% of the area of the county.

Description—Slope gradients range from 0% to 20%. About two thirds of this soil association (Figure 37) is nearly level to undulating (slopes less than 4% in gradient), as indicated in Figure 36. There are some hilly areas in the vicinity of the Pine River in T.38N., R.18E. (Figure 37). These soils occur in eastern townships. The reddish-brown substrata range from loam to clay in texture, with silty clay and clay loam predominant. Coverings of silty and sandy materials are variable in texture and thickness. Depths to highly calcareous glacial drift varies from eight feet in loam material to 30 inches in silty clay material.

Hibbing soils are well drained silt loams to silty clays overlying calcareous red, slightly stony, silty clay glacial till at three to four feet. Zim and Tromald soils are imperfectly and poorly drained, respectively, associates of the Hibbing. Ontonagon soils and associated imperfectly drained Rudyard and poorly drained Pickford and Bergland soils differ from the Hibbing-Zim-Tromald group in being quite free of stones and grit.

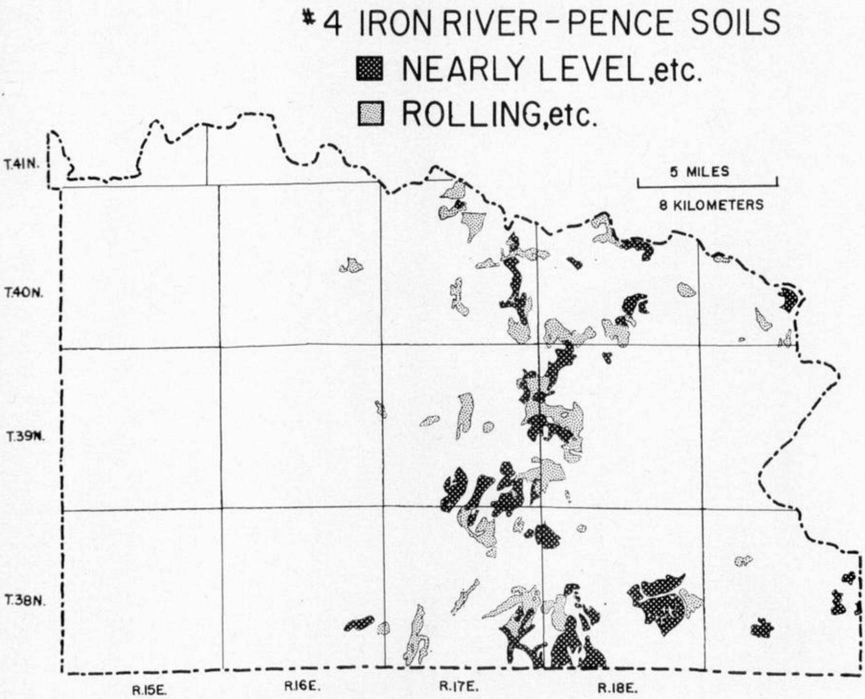


Figure 33. Geographic extent of unit number four on the colored soil map.

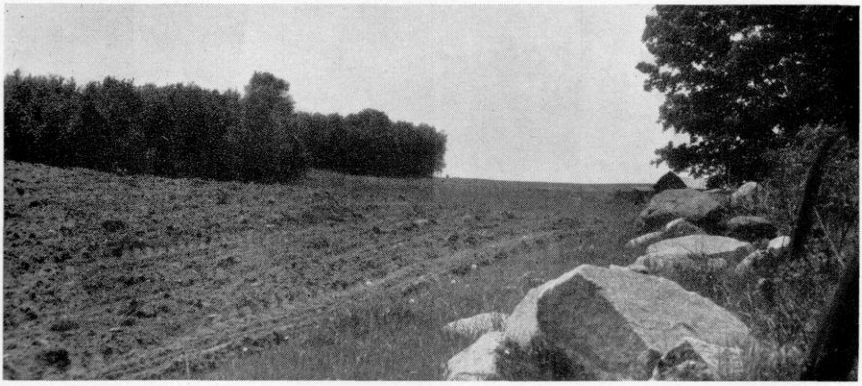


Figure 34. A view of Iron River-Pence Loams (unit number 4 on the colored soil map).

GENERALIZED SOIL KEY NO. 2 FOR USE IN LANDSCAPES OF FLORENCE COUNTY, WISCONSIN

(Note: A soil key for your farm will be simpler. Your agricultural leader can help you prepare a soil key for your vicinity.)

LAY OF THE LAND → SOIL PROFILE → SOIL NAME

SOILS OF SOIL ASSOCIATIONS 5, 14, 15, 16

- **Soils above bogs and streams and therefore not flooded with water nor wet permanently. Soils nearly level to hilly.**
  - Less than 8 inches of surficial silty or sandy soil on red clay or silty clay calcareous at 30-36"
    - Red clay contains stones and is till
      - No mottling .... HIBBING
      - Mottled below 4" .... ZIM
    - Red clay is quite stone-free and is a deposit made in quiet water
      - No mottling .... ONTONAGON
      - Mottled below 4" .... RUDYARD
  - 18 inches to 42 inches of sandy loam or loamy sand over red loam to silty clay loam, calcareous at 5 to 7 feet .... UBLY
  - 5" to 36" of loamy sand or sand over red clay or silty clay, calcareous at 22 to 40 inches
    - Surficial sandy layer is 5-18" thick .... SUPERIOR
    - Sandy layer is 18-36" thick .... DEEP SUPERIOR
  - 18" - 66" of silt and very fine sandy loam over acid very fine to medium sands
    - Surficial layer is 18"-42" thick .... FENCE
    - Surficial layer is more than 42" thick .... DEEP FENCE
  - Less than 18" of silty or fine sandy loam over fine sands, silts, clays, calcareous at 30-100 inches.
    - No mottling .... BOHEMIAN
    - Mottled below 2 inches .... BRIMLEY
  - 18"-42" of sandy loam or loamy sand .... Over acid very fine sand
    - No mottling .... RANDVILLE
    - Mottled below 2 inches .... MOYE
  - 18"-42" of sand or loamy sand
    - Over red loam to silty clay loam, calcareous at 24"-50" .... MENOMINEE
    - Over red silty clay to clay, calcareous at 24"-50" .... MANISTEE
- **Soils on low ground where water stands after rains or where soils are permanently wet.**
  - Less than 8" of surficial silty or sandy soil over clay, calcareous at 14" to 36"
    - 5-inch-thick dark A_1 overlies highly mottled soil
      - Clay contains stones and is till; calcareous at 30" .... TROMALD
      - Clay is quite stone-free and is deposit made in quiet water .... PICKFORD
    - 8" black A_1 over mottled subsoil, which is calcareous at 15 inches .... BERGLAND
  - Deep sand; may be neutral or calcareous at 40"; 3-4-inch "A_1" over mottled sand .... ROSCOMMON
  - Organic soils of bogs; soil more than 12 inches thick over sand, silt loam or clay .... PEATS AND MUCKS

Figure 35.

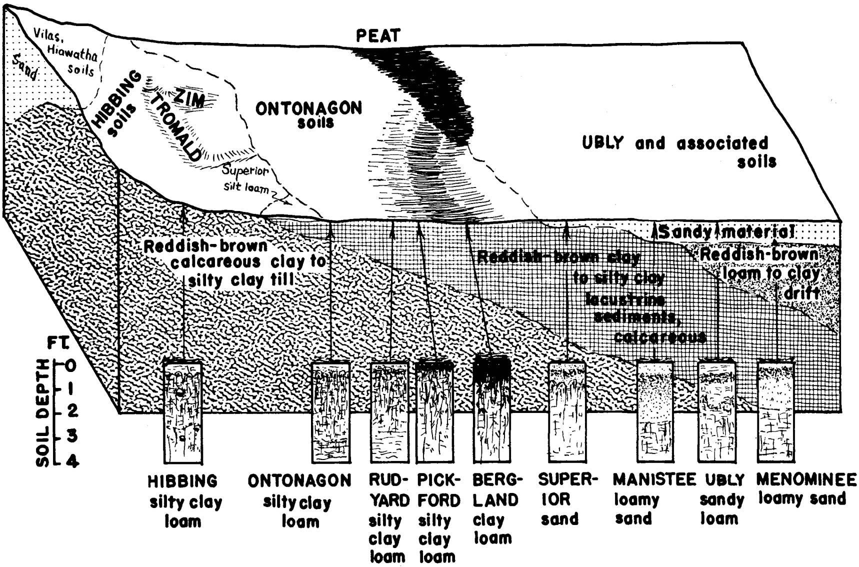


Figure 36. Generalized sketch showing relationships between some soils of eastern Florence County, Wisconsin.

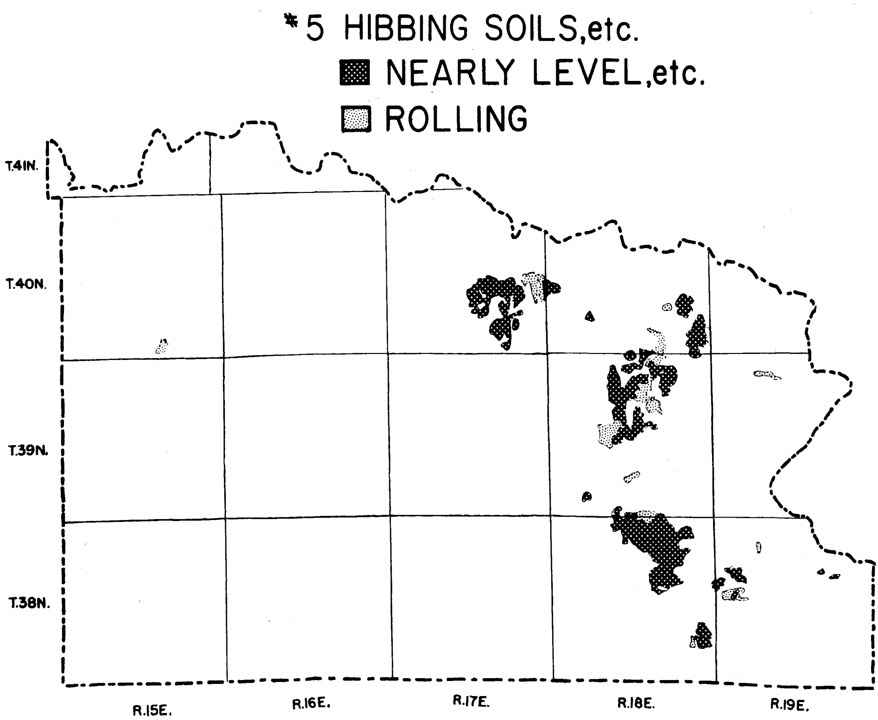


Figure 37. Geographic extents of unit number 5 of the colored soil map.

Ubly sandy loam and loamy sand is underlain at 18 to 42 inches by reddish-brown loam to clay. This is calcareous at five to seven feet.

Manistee and Superior soils have calcareous reddish-brown silty clay to clay substrata at depths of two to four feet. The Manistee soils have 18 to 42 inches of loamy sand above the substratum. Superior soils have five to 18 inches of sand to loam and silt loam covering in the normal phase and 18 to 36 inches of loam or sandy loam covering in the deep phase.

Hiawatha, Crivitz, and Vilas loamy sands are all developed in deep acid sand, which lies at depths of about three feet, two feet, and one foot, respectively. In Florence County Crivitz soils contain more fine sand than is typical for the series.

Goodman and Wakefield soils are silty to depths of about 30 inches and 15 inches, respectively, over reddish-brown, acid loam glacial till.

Soils of the Glacio-fluvial Uplands

Eight soil associations (cartographic units 6, 7, 8, 9, 10, 11, 12, and 13) are included in this group. One or more of the major soils in each association is formed in coarse material, "outwash" sand, and gravel, which presumably was sorted at some stage by "glacio-fluvial action" of running water. These soils are found on uplands just as definitely as are soils formed over glacial till. They occur throughout the county, but the distribution for a given association is concentrated more in one portion than another. The total area occupied by these eight soil associations is 179,619 acres, or 56.4 per cent of the area of the county.

Soils formed from silty or loamy deposits over outwash sand and gravel

Four soil associations (cartographic units 6, 7, 8, and 9) are included in this group. One or more major soils of each association is formed from a silty or loamy layer two or three feet deep over sand and gravel. Map units 6 (nearly level to undulating) and 7 (rolling to hilly) consist dominantly of Stambaugh silt loam. Map units 8 (nearly level to undulating) and 9 (rolling to hilly) consist of a mixture of Stambaugh and Pence soils.

This group of soils has an area of 119,725 acres or 37.6 per cent of the area of the county.

6. Stambaugh and associated soils, nearly level to undulating

Major soils—Stambaugh silt loam and Padus loam.

Minor soils—Fence silt loam, Iron River loam, Vilas loamy sand.

Inclusions—In a belt from the northwest section of T.38N., R.17E. to the southwest sections of T.41N., R.16E., a Stambaugh silt loam, "till substratum phase"

Figure 38. View of a plain occupied by Ontonagon, Manistee, Superior, and associated soils in section 25, T.38N., R.18E. On the hills in the distance are Vilas and Pence soils (units 10 and 12 on the colored soil map).

occurs. This soil differs from the typical Stambaugh in having a stony loam layer six inches to two feet thick between the silty soil profile and the acid outwash sand and gravel beneath (Figures 2 and 14). There are bodies of peat and muck.

Distribution—Largely in the western half of the county (Figure 39).

Area—41,637 acres or 13.1% of the area of the county.

Description—Slope gradients vary between 0% and 8%. These soils occupy nearly level to undulating plains (Figure 41).

The Stambaugh silt loams are two to three feet deep over sand and gravel. The Fence silt loams are 18 inches to five and a half feet deep over fine sand and sand. Padus loams and sandy loams are two to three feet deep to sand and gravel. Pence sandy loams and loams are one to two feet to sand and gravel. Iron River loams differ from Pence in being underlain by stony sandy loam till. Vilas loamy sand is about a foot deep over loose, acid sand.

7. Stambaugh and associated soils, rolling to hilly

Major soil—Stambaugh silt loam.

Minor soils—Padus and Pence loams.

Inclusions—Some bodies of Stambaugh silt loam, "till substratum phase" occur in the same portions of the county as they do in the preceding soil association. There are bodies of peat and muck.

Distribution—Chiefly in the western half of the county (Figure 39).

Area—48,857 acres or 15.3% of the area of the county.

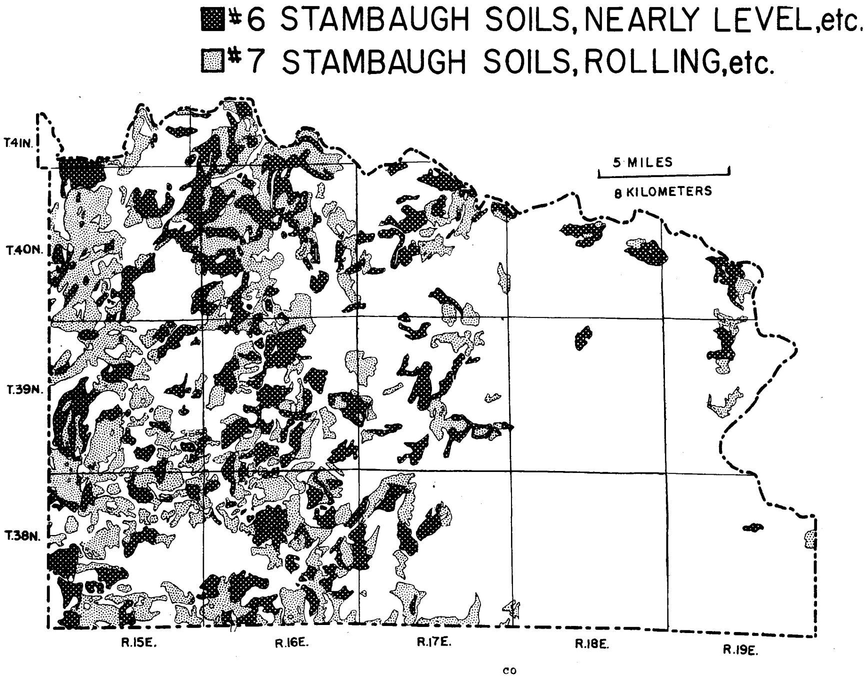


Figure 39. Geographic extents of units 6 and 7 of the colored soil map.

Description—Slope gradients range from 8% to 30%. This is a rolling to hilly landscape which resembles that of the Goodman soils (map unit 2) but is underlain at a depth of two to three feet by sand and gravel, rather than glacial till. The Stambaugh silt loam has a silty covering over the coarse substratum. The Padus and Pence loams (Figure 41) have two to three feet, and one to two feet of loam over the sand and gravel, respectively.

8. Pence, Stambaugh and associated soils, nearly level to undulating

Major soils—Pence sandy loam and loam.

Minor soils—Stambaugh silt loam and Padus loam.

Inclusions—Bodies of peat and muck (Figures 4 and 5).

Distribution—Chiefly in the eastern half of the county, but scattered through all townships.

Area—14,218 acres or 4.5% of the area of the county (Figure 40).

Description—Slope gradients range from 0% to 8%. This is a nearly level to undulating landscape largely underlain by stratified sand and gravel.

Variations in depth of silty and loamy coverings account for the variety of soils found. The Stambaugh, Padus, and Pence soils (Figure 41) have coverings over the sand and gravel of two to three feet of silt, two to three feet of loam, and one to two feet of loam, respectively.

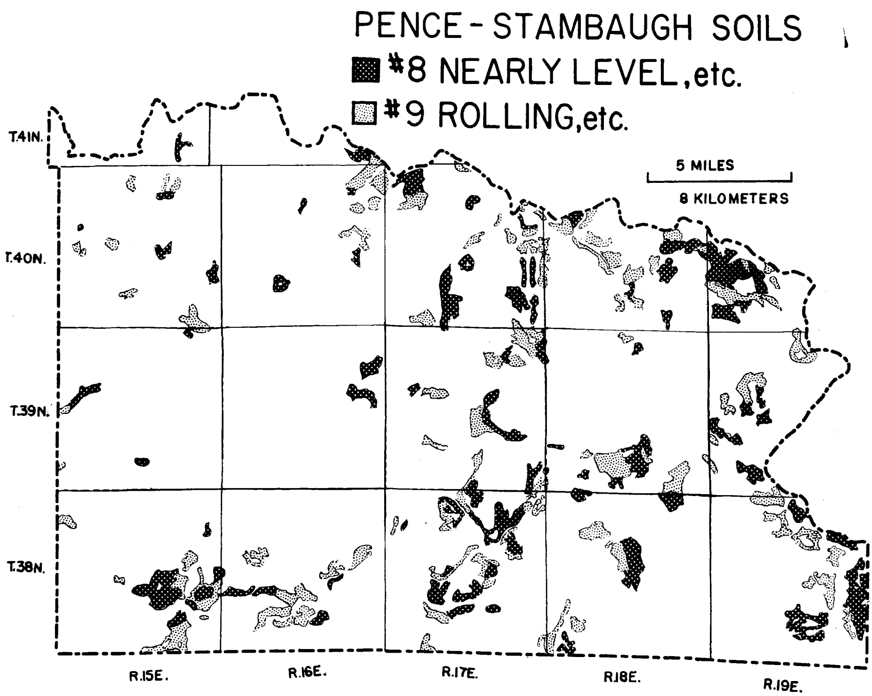


Figure 40. Geographic extents of units 8 and 9 of the colored soil map.

9. Pence, Stambaugh and associated soils, rolling to hilly

Major soils—Pence sandy loam and loam.

Minor soils—Stambaugh silt loam, Padus loam, Iron River sandy loam, Crivitz and Vilas loamy sands.

Inclusions—Bodies of Emmert and Vilas soils; of peat and muck (Figure 41).

Distribution—Chiefly in the eastern half of the county, but scattered through most townships.

Area—15,013 acres or 4.7% of the area of the county (Figure 40).

Description—Slope gradients are between 8% and 30%. This is a rolling to hilly landscape largely underlain by stratified sand and gravel. Stambaugh, Padus, and Pence soils have coverings over coarse material of two to three feet of silt, two to three feet of loam, and one to two feet of loam, respectively. The Crivitz and Vilas loamy sands have coverings over loose sand of 15 to 30 inches and of 12 inches of loamy sand, respectively.

Soils formed from sandy deposits over glacial drift, largely outwash sand

Three soil associations (cartographic units 10, 11, and 12) are included in this group. One or more major soils in each association is formed from stratified sand and gravel which is without any silty covering. Map units 10 and 12 are similar except for topography. Map unit number 11 is extremely sandy. The area of this group amounts to 55,409 acres or 17.4 per cent of the area of the county.

10. Vilas, Pence and associated soils, nearly level to undulating

Major soils—Vilas loamy sand and Pence sandy loam.

Minor soils—Crivitz and Omega loamy sands, Padus loam, and Ubly sandy loam.

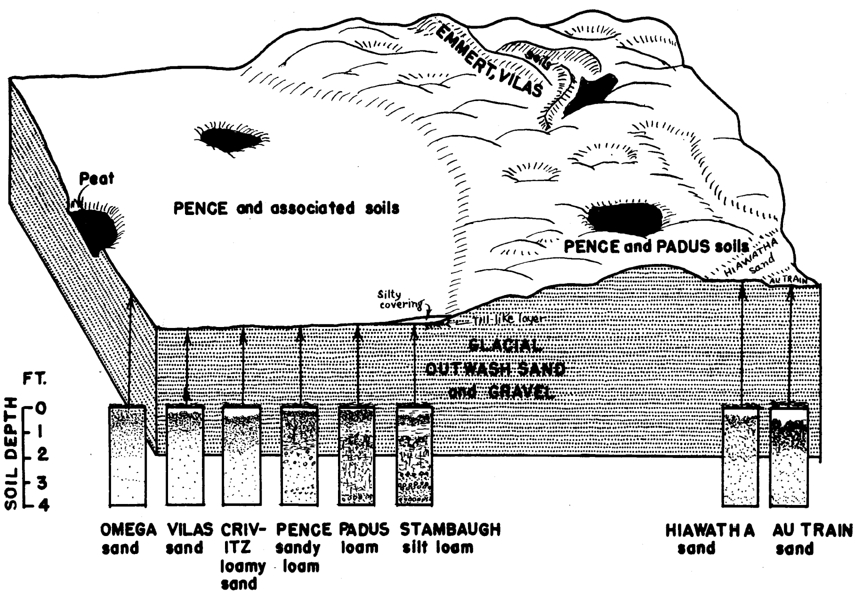


Figure 41. Generalized sketch showing relationships between some soils of Florence County, Wisconsin.

Inclusions—Bodies of peat and muck.

Distribution—Chiefly in the eastern third of the county (Figure 42).

Area—21,725 acres or 6.8% of the area of the county.

Description—Slope gradients are between 0% and 8% (Figure 41). Padus and Pence soils have two to three feet and one to two feet of loam and sandy loam covering over sand and gravel, respectively. Crivitz, Vilas, and Omega loamy sands have 15 to 30 inches, 12 inches, and six inches of loamy sand covering over loose sand, respectively. Crivitz and Omega soils have more fine sand in them in Florence County than is typical of these series.

11. Vilas and associated soils, rolling to hilly

Major soil—Vilas loamy sand.

Minor soils—Crivitz and Hiawatha loamy sands.

Inclusions—Bodies of peat and muck.

Distribution—These are very sandy areas scattered throughout the county (Figure 42).

Area—5,507 acres or 1.6% of the area of the county.

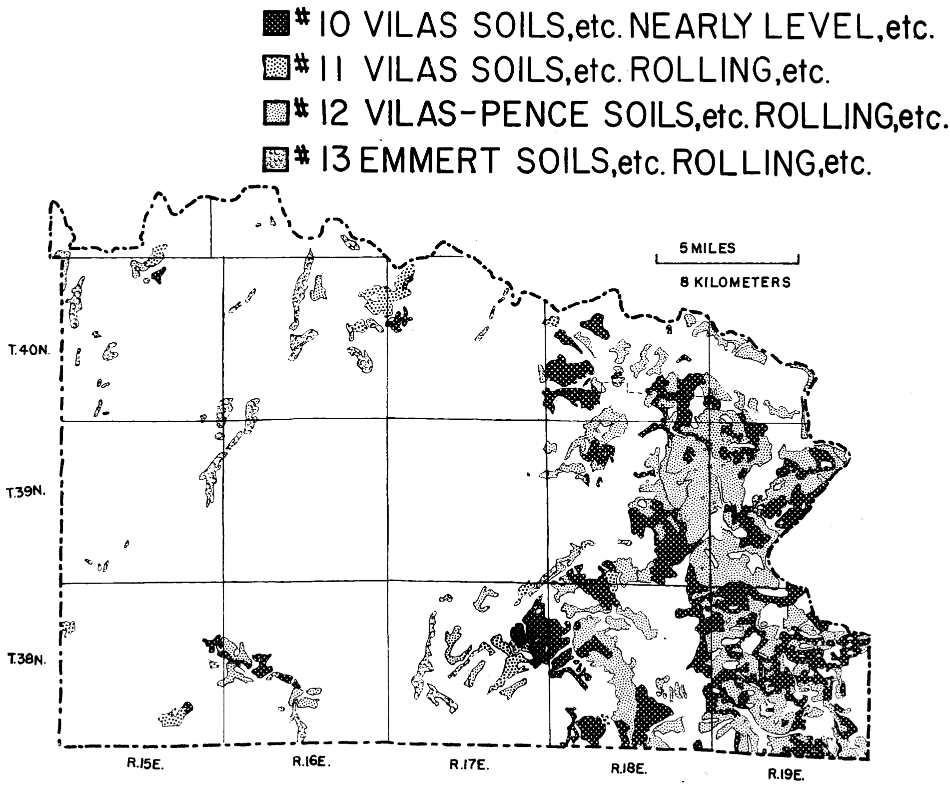


Figure 42. Geographic extents of units 10, 11, 12, and 13 on the colored soil map.

Description—This is an inextensive association of the most sandy soils of the county, all of them loamy sands. Slope gradients are 8% to 30%. Depths of loamy sand covering over loose sand are about three to four feet, two to three feet, and one foot in the Hiawatha, Crivitz, and Vilas soils, respectively.

12. Vilas, Pence and associated soils, rolling to hilly

Major soils—Vilas loamy sand and Pence sandy loam.

Minor soils—Crivitz, Randville, Hiawatha, and Au Train loamy sands; Moye sandy loam.

Inclusions—Bodies of peat and muck.

Distribution—Chiefly in the eastern third of the county (Figure 42).

Area—28,627 acres or 9% of the area of the county.

Description—This is a rolling to hilly landscape (slope gradients 8% to 30%) of loamy sands. The Hiawatha, Crivitz, and Vilas loamy sands have depths of loamy sand covering over loose sand of about three to four feet and one foot, respectively. Randville loamy fine sand (Figure 44) has some loamy fine sand layers in it to a depth of many feet. Au Train soils are characterized by a hardpan within two feet of the surface (Figure 3). The Moye sandy loam is an imperfectly drained associate of the Randville.

13. Emmert, Vilas and associated soils, rolling to hilly

Major soils—Emmert gravelly sandy loam, loam and silt loam.

Minor soils—Vilas loamy sand; Stambaugh silt loam; Pence and Padus loams; Iron River loam and sandy loam.

Inclusions—Bodies of peat and muck.

Distribution—Chiefly in the western half of the county (Figures 25 and 42).

Area—4,485 acres or 1.4% of the area of the county.

Description—This is a spectacular soil association (Figures 29 and 41) and attracts considerable attention because of the abrupt slopes and the pattern of parallel or intertwining ridges.

Emmert soils have a very high content of gravel, stones, and boulders, with local thin coverings of silty or loamy material.

Figure 43. View of Vilas and Pence soils in the N.E.¼ Sec. 31, T.39N., R.19E., looking east. This is unit number 12 on the colored soil map.

There are ridges composed largely of sand. On these Vilas, Pence, Padus, and Stambaugh soils occur, with deeper, finer textured coverings in the order named. Iron River soils are sandy loams and loams over sandy loam till.

Soils of Glacio-lacustrine Basins

Soils formed from deep silty and fine sandy glacio-lacustrine and inwash sediments

This group includes one soil association, map unit 14. The soils formed predominately from silty or fine sandy loam materials over stratified silts, fine sands, and sands. It is not known whether these deposits were laid down in lakes and ponds, or sorted by slowly moving melt-waters (inwash deposits) from the glacier.

14. Fence and associated soils, nearly level to undulating

Major soils—Fence silt loam and fine sandy loam.

Minor soils—Stambaugh and Tipler silt loams; Bohemian and Brimley fine sandy loams; Randville loamy fine sand.

Inclusions—Bodies of peat and muck.

Distribution—Throughout the county, but particularly in southern and western townships (Figure 45).

Area—5,725 acres or 1.8% of the area of the county.

Description—This is a nearly level to undulating landscape (slope gradients 0% to 8%) as indicated in Figures 44 and 46. There are narrow bodies of Fence soils lying between drumlin-like and esker-like ridges (Figure 29) in northwestern Florence County. Locally, some of these soils have had considerable quantities of surficial stones (Figure 20), but this is not typical of the association.

Fence soils are well drained and consist of 18 to 42 inches in the shallow phase and 42 to 66 inches in the deep phase of coarse silt loam and fine sandy loam and very fine sand over fine sand which is acid.

Tipler is the imperfectly drained associate of Fence.

Bohemian (well drained) and Brimley (imperfectly drained) have silty coverings less than 18 inches thick over stratified silts, fine sands and clays, which are calcareous at three feet or more.

Stambaugh soils have two to three feet of silty material over acid sand and gravel.

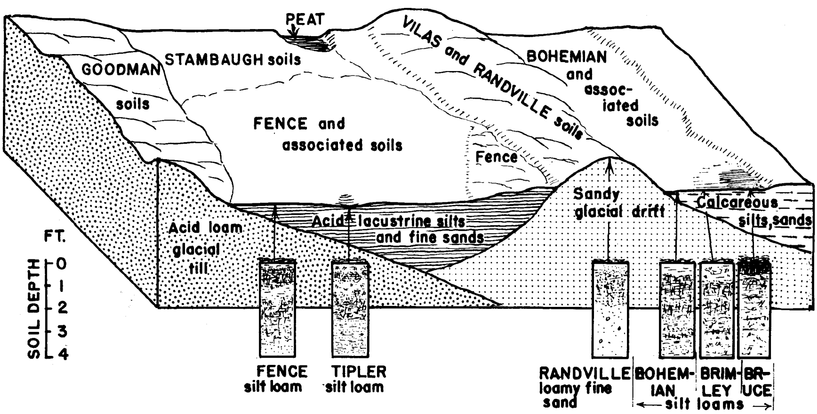


Figure 44. Generalized sketch showing relationships between some soils of Florence County, Wisconsin.

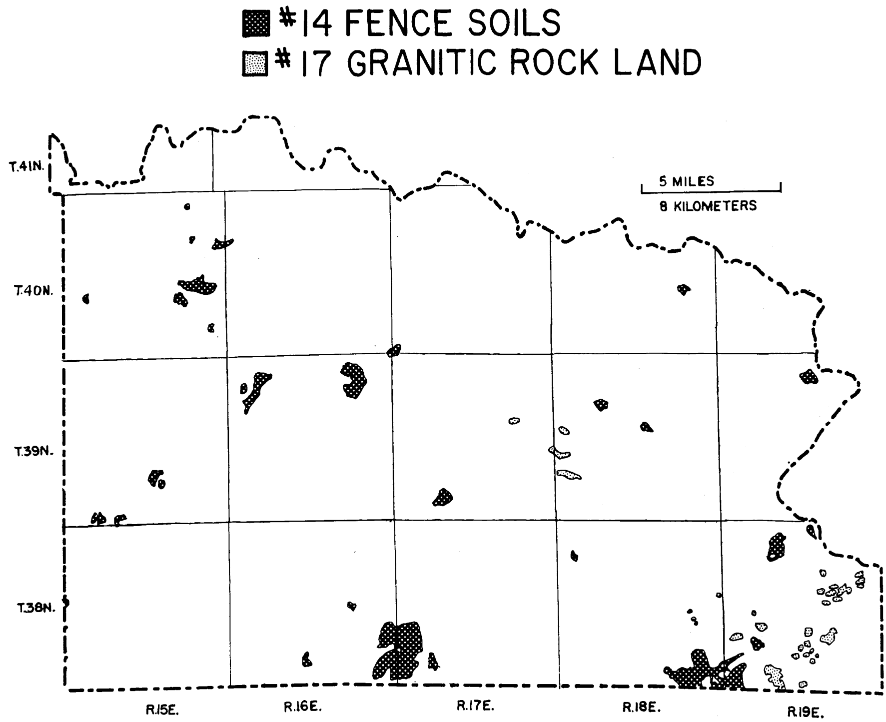


Figure 45. Geographic extents of units 14 and 17 of the colored soil map.

Randville soils are acid loamy fine sands developed in sandier materials than was the Stambaugh.

Soils Formed Largely from Organic Materials

Two soil associations are included in this group (map units 15 and 16), which are differentiated solely on the presence or absence of forest cover. Organic soils are predominant, but poorly drained mineral soils and alluvial soils are also included here. The area involved is 43,420 acres or 13.7 per cent of the area of the county.

15. Peat, muck and associated soils, nearly level to gently sloping, with forest cover

Major soil—Spalding peat.

Minor soils—Linwood peat and muck; Edwards muck; Adolph and Cable loams; Bruce and Brule silt loams; Roscommon fine sandy loam; Alluvial soils, undifferentiated.

Inclusions—Some small, elevated bodies of upland soils and bedrock outcrops.

Distribution—Throughout the county, but with a suggestion of a diagonal grid pattern (see Figure 25) which is probably an expression of bedrock control (N.W. to S.E.) and trends in glacial land forms (N.E. to S.W.).

Area—38,744 acres or 12.2% of the area of the county.

Description—Slope gradients range from 0% to 20%, but these bodies of soil are nearly level (0%–1%) for the most part. These soils occupy the bottoms of kettles

Figure 46. View of a body of Fence silt loam just east of the village of Fence, in southern Florence County, Wisconsin. This small plain occurs in a basin, surrounded by rolling upland.

(Figures 26, 6, and 41), seepage slopes as steep as 20% where bedrock occurs at shallow depths, drainage ways and river bottoms (Figure 23). The surface of peat bogs has an irregular microrelief of mounds of sphagnum moss, shrubs, root systems of trees, both living and dead, logs in various stages of decay and burial. Under white cedar stands on gently sloping peat, adjacent to seepage slopes, mechanical disturbances by trampling by deer in winter "yards" has altered the peat locally.

The Spalding peat consists of more than 42 inches of woody and fibrous, acid organic material. Linwood peat and muck are formed from 12 to 42 inches of organic material over loam glacial drift. Edwards muck consists of 12 to 42 inches of muck over marl (Figure 19).

A variety of mineral soils occur on flat wetlands on the borders of peat bogs, and in depressions isolated from bogs. Among these soils are the poorly drained Cable and Adolph loams and silt loams, which are silty to depths of about two feet and three feet, respectively, overlying acid, glacial drift.

Bruce silt loam is a poorly drained with calcareous silty substratum, associated with fine sandy loams and silt loams of glacio-lacustrine lake basins, such as Bohemian, Brimley, and Fence soils.

Roscommon loamy sand is a poorly drained sandy soil over neutral to slightly calcareous glacial drift.

Brule silt loam is a well drained reddish-brown Alluvial soil which is inextensive. Alluvial soils, undifferentiated, are chiefly poorly drained, and are variable in texture. They occur in the main river valleys in association with peat and muck.

16. Peat, muck and associated soils, nearly level to gently sloping, without forest cover

Major soil—Greenwood peat.

Minor soils—Adolph and Cable silt loams and loams; Brule silt loam and loam; Moye fine sandy loam; and Alluvial soils, undifferentiated.

Inclusions—Some small, elevated bodies of upland soils and bedrock outcrops.

Distribution—Throughout the county in small bodies on which shrubs and mosses are predominant, and trees are scattered or absent.

Area—4,676 acres or 1.5% of the area of the county.

Description—These are chiefly nearly level areas in which wood is a less important soil constituent than in the preceding association.

Greenwood peat consists of more than 42 inches of mossy and fibrous organic material. Cable and Adolph silt loams are mineral soils which are silty to depths of

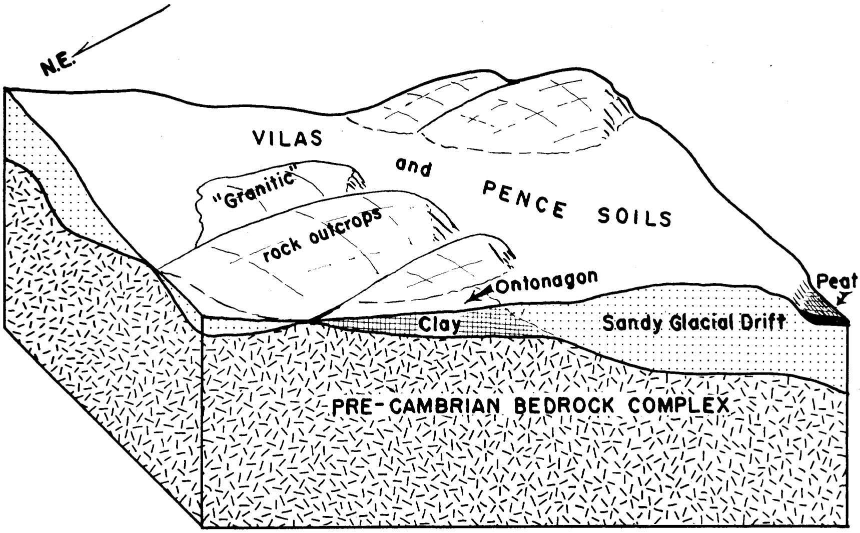


Figure 47. Generalized sketch showing relationships between "granitic" bedrock knobs and intervening bodies of soil in southeastern Florence County, Wisconsin.

about two feet and three feet, respectively, over glacial drift. Brule soils are inextensive well drained Alluvial loams and silt loams, associated with poorly drained Alluvial soils, undifferentiated. Moye fine sandy loam is poorly drained associate of the Randville soils.

"Granitic" Rockland

17. "Granitic" Rockland and associated soils

There is only one soil association (map unit 17) in this inextensive group.

Major soil—"Granitic" rock outcrops. These can be regarded as a soil in a special sense, in that lichens, mosses, grass, shrubs and even trees are found growing on rock outcrops, and in cracks in them.

Minor soils—Pence and Iron River sandy loams and loams; Ontonagon silty clay loams; Stambaugh silt loam; Vilas loamy sand.

Inclusions—Some small bodies of peat and muck.

Distribution—Chiefly in the southeastern townships of the county (Figure 45).

Area—1,018 acres or 0.3% of the area of the county.

Description—The rock outcrops were smoothed by the glacier and are called "roches moutonnés," a French term for "sheep-like rocks," referring to the appearance of a rounded outcrop as seen from a distance. The north-east side of a typical outcrop is well smoothed, while the south-west side (the lee side as far as glacial movement was concerned) is irregular and rough (Figures 47 and 48). Figure 21 shows a close-up view of small plants on an outcrop. The term "granitic" is used with caution, because, as the section of geology of Florence County (page 41) indicates, the bedrock is not true granite.

A variety of soils are associated with rock outcrops, ranging from Spalding peat and Vilas loamy sand to Ontonagon silty clay loam (Figure 49). Stambaugh silt loam, Iron River and Pence loams and Pence loams and sandy loams also occur around rock outcrops. These soils have been described elsewhere in the report.

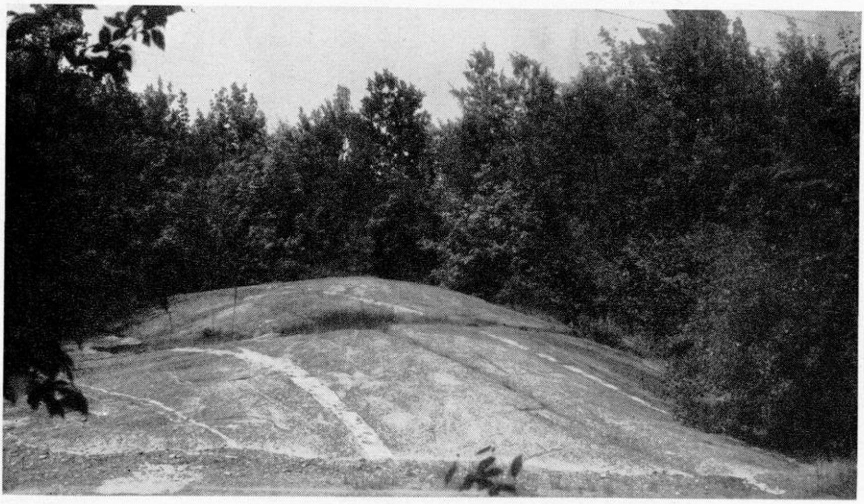


Figure 48. View of bedrock knob looking southwest in the direction in which the glac:er moved as it smoothed the rock outcrop. The far or southwest end of the knob is steep and somewhat broken. Thin soils have formed in joints or cracks, and in depressions in the rock.

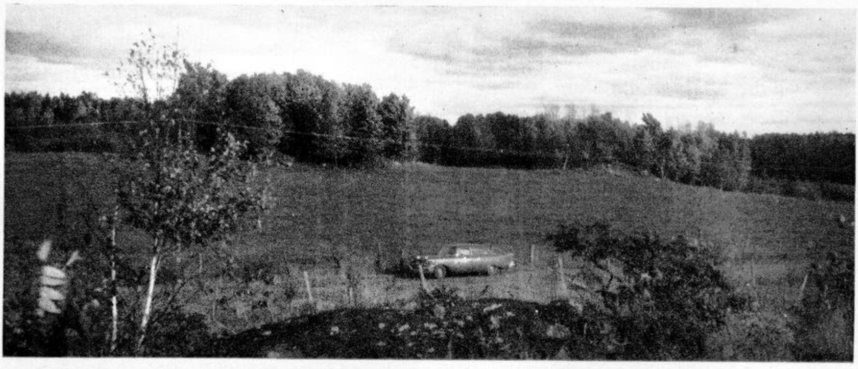


Figure 49. View from a bedrock knob across a field on Ontonagon silty clay loam to other rock knobs.

TABLE XIII. DISTRIBUTION OF SOIL ASSOCIATIONS (SOIL MAP UNITS), FLORENCE COUNTY, WISCONSIN

SOIL MAP SYMBOLS		MAJOR SOIL GROUPINGS	SOIL ASSOCIATIONS (Soil Map Units)	DISTRIBUTION[1]	
Legend Only	Both Legend and Map			Percentage of Area of County	Acres
I	----------	Soils of the Glacial Till Uplands		25.2	80,028
IA	----------	Soils formed from silty to loamy deposits overlying reddish-brown acid sandy loam to clay loam glacial drift, largely till		22.2	70,486
--------	1		Goodman and associated soils, nearly level to undulating	7.2	22,806
--------	2		Goodman and associated soils, rolling to hilly	6.7	21,248
--------	3		Wakefield, Ahmeek and associated soils, nearly level to hilly	2.4	7,761
--------	4		Iron River, Pence and associated soils, nearly level to hilly	5.9	18,671
IB	----------	Soils formed from calcareous, reddish-brown clay loam and silty clay loam glacial drift, largely till, with local sandy covering		3.0	9,542
--------	5		Hibbing, Ubly and associated soils, nearly level to rolling	3.0	9,542
II	----------	Soils of the Glacio-fluvial Uplands		56.4	179,619
IIA	----------	Soils formed from silty or loamy deposits over outwash sand and gravel		37.6	119,725
--------	6		Stambaugh and associated soils, nearly level to undulating	13.1	41,637
--------	7		Stambaugh and associated soils, rolling to hilly	15.3	48,857
--------	8		Pence, Stambaugh, and associated soils, nearly level to undulating	4.5	14,218
--------	9		Pence, Stambaugh and associated soils, rolling to hilly	4.7	15,013
IIB	----------	Soils formed from sandy deposits over glacial drift, largely outwash sand		17.4	55,409
--------	10		Vilas, Pence, and associated soils, nearly level to undulating	6.8	21,725
--------	11		Vilas and associated soils, rolling to hilly	1.6	5,057
--------	12		Vilas and Pence and associated soils, rolling to hilly	9.0	28,627

TABLE XIII. DISTRIBUTION OF SOIL ASSOCIATIONS (SOIL MAP UNITS), FLORENCE COUNTY, WISCONSIN—Continued

SOIL MAP SYMBOLS		MAJOR SOIL GROUPINGS	SOIL ASSOCIATIONS Soil Map Units)	DISTRIBUTION[1]	
Legend Only	Both Legend and Map			Percentage of Area of County	Acres
IIC	----------	Soils formed from stony, gravelly and sandy glacial drift, largely outwash		1.4	4,485
--------	13		Emmert, Vilas and associated soils, rolling to hilly	1.4	4,485
III	----------	Soils of the glacio-lacustrine Basins		1.8	5,725
IIIA	----------	Soils formed from deep silty and fine sandy glacio-lacustrine and inwash sediments		1.8	5,725
--------	14		Fence and associated soils, nearly level to undulating	1.8	5,725
IV	----------	Soils formed largely from organic materials		13.7	43,420
--------	15		Peat, muck and associated soils, nearly level to gently sloping, with forest cover	12.2	38,744
--------	16		Peat, muck, and associated soils, nearly level to gently sloping, without forest cover	1.5	4,676
V	17	"Granitic" Rockland	"Granitic" Rockland and associated soils	0.3	1,018
Water				2.6	8,270
Totals for Florence County				100.0	318,080

[1]Percentages are based on weights of various parts of the soil map, as determined with an analytical balance.

TABLE XIV. DISTRIBUTION OF SOILS IN THE SOIL ASSOCIATIONS (SOIL MAP UNITS), FLORENCE COUNTY, WISCONSIN

SOIL MAP SYMBOL	SOIL ASSOCIATION (Soil Map Unit)	SOIL TYPES	DISTRIBUTION	
			Percentage of Area of County	Acres
1	Goodman and associated soils, nearly level to undulating		7.20	22,806
		Goodman silt loam	6.20	19,613
		Auburndale silt loam	0.30	912
		Stambaugh silt loam	0.30	912
		Iron River loam, silt loam	0.30	912
		Gaastra silt loam	0.10	457
2	Goodman and associated soils, rolling to hilly		6.70	21,248
		Goodman silt loam	5.60	17,848
		Wakefield silt loam	0.40	1,275
		Iron River loam, silt loam	0.30	1,275
		Stambaugh silt loam	0.20	637
		Padus loam	0.10	107
		Pence loam	0.10	106
3	Wakefield, Ahmeek and associated soils, nearly level to hilly		2.40	7,761
		Wakefield silt loam	1.30	4,269
		Ahmeek silt loam, loam, stony loam	0.60	1,940
		Iron River loam, silt loam	0.30	1,164
		Pence loam	0.10	233
		Padus loam	0.10	155
4	Iron River, Pence and associated soils, nearly level to hilly		5.90	18,671
		Iron River loam and sandy loam	3.30	11,203
		Pence loam and sandy loam	1.10	3,703
		Goodman silt loam	0.60	1,867
		Padus loam	0.40	1,307
		Vilas loamy sand	0.10	119
		Hiawatha loamy sand	0.10	118
		Hibbing silt loam	0.10	118
		Wakefield silt loam	0.10	118
		Randville loamy fine sand	0.10	118
5	Hibbing, Ubly, and associated soils, nearly level to rolling		3.00	9,542
		Hibbing silt loam, silty clay loam	1.10	3,982
		Ubly loam, sandy loam	0.60	2,426
		Manistee loamy sand	0.30	954
		Superior sandy loam	0.10	360
		Crivitz loamy fine sand	0.10	360
		Ontonagon silty clay loam	0.10	285
		Wakefield silt loam	0.10	180
		Goodman silt loam	0.10	180
		Zim silt loam, silty clay loam	0.10	180
		Rudyard loam, silty clay	0.10	180
		Menominee loamy sand	0.10	180
		Vilas loamy sand	0.10	180
		Hiawatha loamy sand	0.10	95
6	Stambaugh and associated soils, nearly level to undulating		13.10	41,637
		Stambaugh silt loam	7.70	24,149
		Padus loam	2.10	6,662
		Fence silt loam	1.80	5,829
		Pence loam	1.30	4,164
		Vilas loamy sand	0.10	417
		Iron River loam	0.10	416

TABLE XIV. DISTRIBUTION OF SOILS IN THE SOIL ASSOCIATIONS (SOIL MAP UNITS), FLORENCE COUNTY, WISCONSIN—Continued

SOIL MAP SYMBOL	SOIL ASSOCIATION (Soil Map Unit)	SOIL TYPES	DISTRIBUTION Percentage of Area of County	Acres
7	Stambaugh and associated soils, rolling to hilly		15.30	48,857
		Stambaugh silt loam	10.70	34,200
		Padus loam	2.30	7,329
		Pence loam	2.30	7,328
8	Pence, Stambaugh and associated soils, nearly level to undulating		4.50	14,218
		Pence sandy loan and loam	3.60	11,374
		Stambaugh silt loam	0.50	1,422
		Padus loam	0.40	1,422
9	Pence, Stambaugh and associated soils, rolling to hilly		4.70	15,013
		Pence loam, sandy loam	3.70	11,710
		Stambaugh silt loam	0.40	1,501
		Padus loam	0.30	901
		Crivitz loamy sand	0.10	301
		Vilas loamy sand	0.10	300
		Iron River sandy loam	0.10	300
10	Vilas, Pence and associated soils, nearly level to undulating		6.80	21,725
		Vilas loamy sand	3.90	12,601
		Pence sandy loam	1.30	3,911
		Crivitz loamy sand	0.70	2,173
		Omega loamy sand	0.70	2,172
		Padus loam	0.10	434
		Ubly sandy loam	0.10	434
11	Vilas and associated soils, rolling to hilly		1.60	5,507
		Vilas loamy sand	1.50	4,905
		Crivitz loamy sand	0.10	101
		Hiawatha loamy sand	0.10	51
12	Vilas, Pence and associated soils, rolling to hilly		9.00	28,627
		Vilas loamy sand	4.10	12,882
		Pence sandy loam	3.50	11,451
		Crivitz loamy sand	0.80	2,576
		Randville loamy sand	0.30	859
		Hiawatha loamy sand	0.10	287
		Au Train loamy sand	0.10	286
		Moye sandy loam	0.10	286
13	Emmert, Vilas and associated soils, rolling to hilly		1.40	4,485
		Emmert gravelly sandy loam, loam, silt loam	0.80	2,691
		Vilas loamy sand	0.20	718
		Stambaugh silt loam	0.10	449
		Pence loam, sandy loam	0.10	359
		Padus loam	0.10	224
		Iron River sandy loam	0.10	44
14	Fence and associated soils, nearly level to undulating		1.80	5,725
		Fence silt loam, fine sandy loam	1.30	4,809
		Stambaugh silt loam	0.10	344
		Tipler silt loam, loam	0.10	286
		Bohemian fine sandy loan	0.10	115
		Brimley fine sandy loam	0.10	115
		Randville loamy fine sand	0.10	56

TABLE XIV. DISTRIBUTION OF SOILS IN THE SOIL ASSOCIATIONS (SOIL MAP UNITS), FLORENCE COUNTY, WISCONSIN—Continued

SOIL MAP SYMBOL	SOIL ASSOCIATION (Soil Map Unit)	SOIL TYPES	DISTRIBUTION	
			Percentage of Area of County	Acres
15	Peat, muck and associated soils, nearly level to gently sloping with forest cover		12.20	38,744
		Spalding peat	8.80	27,127
		Linwood peat, muck	0.70	2,324
		Adolph loam, silt loam	0.70	2,324
		Cable loam, silt loam	0.70	2,324
		Roscommon loamy sand	0.40	1,162
		Edwards muck	0.10	387
		Alluvial soils, undifferentiated	0.10	387
		Bruce silt loam	0.10	387
		Brule silt loam	0.10	387
		Saugatuck loamy sand	0.10	387
		Bergland silty clay loam	0.10	387
		Brimley fine sandy loam	0.10	387
		Tromald silty clay loam	0.10	387
		Pickford silty clay loam	0.10	387
16	Peat, muck, and associated soils, nearly level to gently sloping, without forest cover		1.50	4,676
		Greenwood peat	1.00	3,413
		Moye fine sandy loam	0.10	374
		Adolph loam, silt loam	0.10	374
		Cable loam, silt loam	0.10	374
		Alluvial soils, undifferentiated	0.10	92
		Brule silt loam, loam	0.10	49
17	"Granitic" Rockland and associated soils		0.30	1,018
		"Granitic" rock outcrops	0.20	611
		Pence loam, sandy loam	0.03	132
		Vilas loamy sand	0.03	132
		Spalding peat	0.01	51
		Ontonagon silty clay loam	0.01	51
		Iron River sandy loam	0.01	31
		Stambaugh silt loam	0.01	10
WATER			2.60	8,270
Totals for Florence County, Wisconsin			100.00	318,080

VIII. APPENDIX

Glossary[1]

A horizon—The surface horizon of an undisturbed mineral soil. It is usually subdivided into several subhorizons. The A_1 is dark colored and high in organic matter; the A_2 is usually light colored and leached; the A_3 is transitional to the B horizon. Some soils have all of these subdivisions, others do not.

A_p horizon—A plowed or otherwise mixed surface layer.

A_x horizon—A pale fragipan, which is a dense subsoil layer exhibiting softness when wet and hardness when dry.

Aggregate—A cluster of soil particles (synonym for "ped").

Alluvium—Soil material deposited by streams.

Association, Soil—A group of soils which may or may not resemble each other, but which are geographically associated together in a particular pattern.

B horizon—A master horizon or layer in a soil profile usually found below the A horizon. It is usually characterized by stronger colors (usually brown) than those in horizons above or below, by an accumulation of iron, clay, or organic matter, and by a blocky structure. It is usually subdivided into several subhorizons.

B_h—A dark brown horizon high in content of organic matter.

B_{ir}—A brown B horizon high in content of iron.

B_t—A B horizon having an accumulation of clay. This is sometimes called the "B_2" horizon.

B_x or *B_m*—Dark fragipan, which is a dense subsoil layer with a slightly higher content of clay than the A_x horizon.

Bisequal (soil)—A soil having two sequa, one above the other. For example, a Podzol A_2 and B_{hir} sequum over a Gray-Brown Podzolic A_2 and B_t sequum constitute a bisequal soil.

Bog (soil)—An organic soil.

Bog (peat)—A peat deposit, usually consisting of moss peat, upon which plants are growing. Bogs are usually found in enclosed depressions.

Brown Podzolic (soil)—See footnote number 3, Table I.

C horizon—A layer of relatively unweathered material similar to the material from which at least a part of the soil above it was formed. Soil parent material.

Calcareous (soil)—Soil containing free lime which effervesces when dilute (1:10) HCl is applied.

Catena—A group of soils developed from similar parent material but differing in morphology because of differences in natural drainage conditions.

Clay—The smallest mineral grains, less than 0.002 mm in diameter.

Clay (texture)—Soil that contains 40% or more clay, less than 45% sand, and less than 40% silt.

Clay loam—Soil consisting of 27% to 40% clay and 20% to 45% sand.

Colluvium—Deposit of soil accumulated at the base of a slope under the influence of gravity. Slope wash.

Complex, Soil—Several soils, so closely intermingled that they cannot be shown separately on a map at the scale being used.

[1] Prepared largely by Professor G. B. Lee, Soil Survey Division, Wis. Geol. and Nat. Hist. Survey, Univ. of Wis.

Consistence, Soil—The resistance of soil to separation or deformation. Soil consistence varies with moisture content. It is described in terms such as loose, friable, firm, hard, sticky.

D horizon—A layer or stratum below the C horizon, or the B horizon if no C is present, which is unlike the C or the material from which the B horizon has been formed.

Drainage, Soil—Natural soil drainage refers to the speed with which water is removed from the soil surface and through the soil itself. Seven classes have been recognized: excessive, somewhat excessive, well, moderately well, imperfect, poor, and very poor. Artificial drainage refers to removal of water by ditching, tiling, and construction of surface water ways and terraces.

Drift—Glacial deposits, both ice-laid and water-laid.

Drumlin—An oval or cigar-shaped hill of glacial drift (usually till), ordinarily with its long axis parallel to the movement of ice which formed it.

Eluvial (horizon)—A horizon that has lost bases, iron, clay, etc. by processes of soil formation. A_2 horizons are eluvial.

Exchangeable cations—Available plant nutrients in the form of cations (such as ions of calcium, magnesium, potassium) in soils, determined in me/100 gm with a flame photometer on leachate.

Fragipan—Brittle, dense, loamy, reversibly cemented subsoil horizon which is resistant to root growth and water movement, is friable when wet, and is hard when dry.

G or g—A soil horizon that is gleyed.

Glacial drift—See *drift.*

Glacial till—Unsorted glacial drift transported and deposited by ice.

Glacio-fluvial deposits—Sediments deposited by glacial streams. These deposits are usually sandy or gravelly and are typically stratified.

Glacio-lacustrine deposits—Sediments deposited in glacial lakes. These include fine sands, silts and clays. They may be stratified or varved.

Gleyed (soil)—Soil material which is olive gray or bluish gray in color. Gleyed horizons are usually found below a dark colored surface layer in poorly drained soils.

Gray-Brown Podzolic—The kind of soil which usually developed under forest vegetation in southern Wisconsin. These soils have light colored surface horizons, brown illuvial (clayey) subsoils, and are generally acid.

Gray Wooded—See footnote Number 5, Table I.

Horizon, Soil—A layer of soil more or less parallel to the land surface and having characteristics produced by processes of soil formation.

Humic Gley—A naturally poorly drained soil having a thick, dark colored surface horizon and a gray (gleyed) subsoil.

Illuvial horizon—Horizons that have received material (bases, clay, etc.) from an eluvial horizon. B horizons of Gray-Brown Podzolic and Podzol soils are illuvial.

Intergrade—A soil that does not clearly belong to any great soil group but has some characteristics of several groups.

Leaching—Removal of material from soil in solution by percolating water. For example, the removal of lime from the upper part of a soil is a leaching process.

Lithosol—A shallow soil consisting of a dark colored surface soil underlain by bedrock.

Loam (texture)—Soil that contains 7% to 27% clay, 28% to 50% silt, and less than 52% sand.

Loamy sand—Soil that contains at the upper limit 85% to 90% sand, and the percentage of silt plus 1½ times the percentage of clay is less than 15. At the lower limit it contains not less than 70% to 85% sand, and the percentage of silt plus twice the percentage of clay does not exceed 30.

Marl—An earthy deposit consisting of calcium carbonate (lime), silt and clay. It is found in lake bottoms or below peat.

Marsh—A wet area supporting sedge, grass and reed vegetation.

Morphology, Soil—This refers to the physical constitution of the soil, including such characteristics as the color, texture, structure, and consistency of the various horizons, their thickness and arrangement in the soil profile.

Mottled—Somewhat spotted appearance, as in the case of soil which shows splotches of rust and gray colors. Mottling in most of the soils in Wisconsin indicates that natural drainage is restricted, or that the water table rises to near the surface periodically.

Muck—Organic soil material that is partially decomposed. Muck is usually dark in color.

Organic Soil—Soil formed from organic materials. Peat and muck are organic soils and are classified in the Bog great soil group.

Outwash—Sorted sand and gravel deposited by glacial melt waters flowing out from the glacier.

Parent material—The material from which a soil formed, such as sandy loam glacial till, deep sand, woody peat.

Particle size distribution (of soil)—This is a synonym for *texture* and refers to the percent by weight of clay and silt (determined by hydrometer method of Day, 1957, in this study), and sands (determined with sieves) in dry mineral soil.

Peat—Organic soil material that is relatively undecomposed. This material may be broken up (disintegrated), but plant parts can still be recognized. When peat undergoes decomposition it becomes muck.

Ped (soil)—A soil aggregate. A ped may be blocky, platy, prismatic, granular in shape.

pH—A notation used to designate the acidity or alkalinity of a soil. A pH of 7.0 indicates neutrality. Lower values indicated acidity and higher values, alkalinity.

Phase, Soil—A subdivision of a soil unit based on features significant to man's use of a soil. For example: sloping phase, stony phase.

Profile, Soil—A vertical section through a soil, exposing all of its horizons, including the parent material.

Reductant-soluble Fe = This refers to "free iron" in soil. Free iron is determined by reducing and complexing the iron in a neutral system (Jackson, 1956, 1958).

Regosol—A shallow soil consisting of an A horizon over unweathered, unconsolidated parent material.

Sand—Mineral grains having diameters ranging between 2 and 0.05 mm.

Sand (texture)—Soil consisting of 85% or more of sand. The percentage of silt plus 1½ times the percentage of clay shall not exceed 15. Coarse sand, sand, fine sand, and very fine sandy subclasses are recognized

Sandy clay loam—Soil that consists of 20% to 35% clay, less than 28% silt, and 45% or more of sand.

Sandy loam—Soil consisting of either 20% clay or less; and the percentage of silt plus twice the percentage of clay exceeds 30; and 52% or more of sand: or less than 7% clay, less than 50% silt, and between 43 and 52% of sand.

Sequum—A sequence of an eluvial horizon and its related illuvial horizon.

Silt—Mineral grains ranging in size from 0.05 to 0.002 mm in diameter. Soil material containing more than 80% silt and less than 12% clay is included in the silt class.

Silty clay—Soil that contains 40% or more of clay and 40% or more of silt.

Silty clay loam—Soil consisting of 27% to 40% clay and less than 20% sand.

Silt loam—Soil consisting of 50% or more of silt and 12% to 27% of clay; or 50% to 80% of silt and less than 12% of clay.

Sol Brun Acide—A group of soils formed under forest vegetation from moderately acid parent materials in the podzolic soil region. These soils exhibit little or no eluviation and illuviation of oxides and clay. Some formation of clay may have occurred.

Structure, Soil—This refers to the aggregation of primary soil particles into compound particles such as granules, blocks, prisms, or plates.

Swamp—A wet area supporting woody vegetation, usually tamarack.

Texture, Soil—This refers to the relative proportions of the various size groups of individual soil grains.

Till—See *glacial till.*

Variant, Soil—A soil of limited or unknown extent but having characteristics unique enough to set it apart from a related series. The term *variant* is usually used temporarily until the soil can be studied further. *Phase* is sometimes used in the same sense.

Analytical Data for Some Soils of Florence County, Wisconsin

Tables XV, XVI, and XVII present results of laboratory analyses made by the authors, Dr. R. B. Corey, Mr. Clyde C. Applewhite, and others. Analyses were made by the following methods:

1. A Beckman pH meter was used in measuring the reaction of soil paste that had stood at the saturation point for 30 minutes.
2. Bulk density for Tables XV and XVII was determined from soil cores taken with metal cylinders. Samples from sandy horizons were emptied from the cylinders into bags in the field. Samples from silty horizons were left in the cylinders until after drying, paraffin coating, and weighing in both air and in water. Bulk density for Table XVI was determined for paraffin-coated soil peds.
3. Particle size distribution analysis (Day; 1957) was made of the mineral soil fractions by using U.S.D.A. standard sieves for the sands, and an A.S.T.M. 152 H soil hydrometer with Bouyoucos scale in 1,000 M.L. graduate cylinders in a constant-temperature room for determining silt and clay contents. Samples were dispersed with 1 per cent "Calgon" solution. Each analysis totals 100 per cent since the hydrometer data were plotted in a cumulative curve.

4. Reductant soluble free iron was determined by reducing and complexing the iron in a neutral system (dithionite-citrate-bicarbonate method). (M. L. Jackson, 1956, 1958).
5. Organic carbon was determined by the Walkley-Black method of oxidation by chronic acid with H_2SO_4 heat of dilution.
6. Total per cent nitrogen was determined by the Kjeldahl procedure.
7. Exchangeable cations and cation exchange capacity were determined by methods described by Jackson (1956, 1958).
8. Available nitrogen, phosphorus and potassium were determined by methods used in the State Soil Testing Laboratory, and in related laboratories, Soils Department, University of Wisconsin, at Madison.
9. Total titanitum and iron, mobile silica, and exchangeable alumina were determined by procedures described by Jackson (1958).
10. Grams of roots per square foot per horizon of soil were determined by gently washing soil on a fine screen to remove soil from roots with water; drying roots, and weighing them.
11. Identification of clay minerals was made by methods described by Jackson (1956).

Abbreviations Used in Tables XV, XVI, and XVII

a, A	=	acre
Al_2O_3	=	alumina, determined by the method of Jackson (1956)
avail.	=	available
BD, B.D.	=	bulk density
Bk	=	pH as determined with the Beckman pH meter, except for the Hibbing loam in Table XVII.
C	=	carbon, as determined by a modified Walkley-Black procedure.
c	=	clay
Ca	=	calcium
cc	=	cubic centimeter
cl	=	clay loam
co	=	coarse
cos	=	coarse sand
csi	=	coarse silt (.02–.05 mm dia. particles)
C.E.C.	=	cation exchange capacity in me/100 gm, determined by EDTA titration procedures of R. B. Corey, University of Wisconsin.
Ex. Sat.	=	exchange saturation
f	=	fine
F	=	fermenting layer of decomposing litter just above the humus of a soil.
Fe	=	iron
Fe_2O_3	=	iron oxide, determined by method of Jackson (1956).
fs	=	fine sand or fine sandy
fsi	=	fine silt (.002–.005 mm particles)
fsl	=	fine sandy loam
g	=	mottled
gm	=	gram
G	=	gravel or gravelly
gr	=	gritty
h,H	=	humus; organic matter
horiz.	=	horizon of a soil profile
hvy	=	heavy (contains some clay)
K	=	potassium ("wet" means that the determination of K was made on moist soil as collected in the field; "dry" means that the determination was made on soil after drying)
L	=	leaf litter
l	=	loam or loamy

ls = loamy sand
lfs = loamy fine sand
lbs = pounds
m = medium (Also see B_m in Glossary)
msi = medium silt (.005–.02 mm dia. particles)
mat. = material
me = millequivalents
Mg = magnesium
mm = millimeter
ms = medium sand
msl = medium sandy loam
Mu = muck or mucky
Na = sodium
N = nitrogen, determined by modified Kjeldahl procedure for total N.
O.M. = organic matter; determination based on determination of carbon.
P = phosphorus; determination by University of Wisconsin Soils Testing Lab. procedure unless the Bray test is indicated.
Pe = peaty or peat
pH = values which express degrees of acidity or alkalinity of a material.
roots = roots, dry weight in grams, in one inch layer of soil over one square foot of area.
s = sand or sandy
sat. = saturation
scl = sandy clay loam
si = silt or silty
sil = silt loam
SiO_2 = silica, determined by method of Jackson (1956)
sl = sandy loam
sq. = square
st = stony
Tg = pH as determined by Truog soil rest reaction kit.
Ti = titanium
Tr = trace
u = micron or 0.001 mm
v = very
vcs = very coarse sand
vfs = very fine sand or very fine sandy
vfsl = very fine sandy loam

TABLE XV. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN

AU TRAIN LOAMY SAND
(N. E. Corner Sec. 17, T. 38 N., R. 19 E.)

Horizon	Depth	pH	BD	Particle size distribution analysis									Texture	Oven-dry roots/ ft.²x1″
				c	fsi	msi	csi	vfs	fs	ms	cs	vcs		
	Inches	Bk		%	%	%	%	%	%	%	%	%		gm
Undisturbed soil														
L	2¼″-1¼″													
F	1¼″- ¼″	----	0.14	----	----	----	----	----	----	----	----	----	----	0.16
H	¼″- 0″													44.13
A_{21}	0″-1¼″	4.1	0.91	6	2	10	6	4	22	28	22	tr	l m s	19.63
A_{22}	1¼″- 8″	5.2	1.34	4	3	3	3	5	27	31	24	tr	m s	2.05
A_{23}	8″-8¾″	5.1	----	7	2	4	3	4	25	24	31	tr	m s	----
B_{irh_1}	8¾″- 12″	5.3	1.23	12	2	5	4	4	25	25	22	1	l m s	1.65
B_{irh_2}	12″-21″	5.5	1.56	9	2	3	3	6	28	24	25	tr	l m s	0.54
B_{irh_3}	21″-25″	5.4	1.40	6	0	3	1	7	33	29	21	tr	l m s	----
$B_{(m)}$	25″-46″	5.6	1.57	5	0	2	2	9	27	20	34	1	l m s	----
C_1	46″-54″	5.4	1.56	5	0	0	0	5	30	24	36	tr	m s	----
C_2	54″-59″	5.3	----	2	1	0	1	6	28	23	38	1	m s	----
C_3	59″-64″	5.2	----	4	0	0	1	4	20	20	50	1	m s	----
C_4	64″-72″	5.1	----	4	2	3	2	15	31	22	21	tr	m s	----
C_5	72″-78″	4.8	----	2	0	1	1	2	15	23	55	1	m s	----
C_6	78″-84″	5.1	----	3	1	1	1	11	40	23	19	1	m s	----
Cultivated soil														
AA_p	0″- 8″	6.2	1.37	6	2	3	2	5	27	34	21	tr	l s	3.90
A_2	8″-14″	6.2	1.51	3	1	2	1	4	24	37	27	1	m s	0.08
B_{irh_1}	14″-23″	5.2	1.29	8	1	1	1	4	23	34	27	1	m s	0.27
B_{irh_2}	23″-30″	5.1	1.41	6	0	1	0	3	24	29	35	2	l m s	----
B_{irh_3}	30″-40″	4.8	1.45	7	0	3	2	4	26	30	26	2	m s	----
$B_{(m)}$	40″-46″	5.1	1.44	3	1	0	2	1	24	28	40	1	m s	----
C_1	46″-68″	5.3	1.38	2	0	0	0	5	28	56	8	1	m s	----

Subscript "m" signifies fragipan.

TABLE XV. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

AU TRAIN LOAMY SAND
(N. E. Corner Sec. 17, T. 38 N., R. 19 E.)

Horizon	Depth	C	N	Avail. P	Avail. K		CEC	Exchangeable Cations				Reduc-tant-soluble Fe	Total Fe	Total Ti
					Dry	Wet		Ca	Mg	K	Na			
	Inches						m.e. per 100 g.					%	%	%
Undisturbed soil														
L $2\frac{1}{4}$–$1\frac{1}{4}$″	----	----	----	----	----	----	----	----	----	----	----	----	----	----
F $1\frac{1}{4}$–$\frac{1}{4}$″	----	----	----	----	----	----	----	----	----	----	----	----	----	----
H $\frac{1}{4}$–0″	----	----	----	----	----	----	----	----	----	----	----	----	----	----
A_{21}	0″–$1\frac{1}{4}$″	1.76	0.111	4.0	60	100	6.81	0.87	0.27	0.08	0.02	----	----	----
A_{22}	$1\frac{1}{4}$″–8″	0.28	0.014	0.0	20	22	3.71	0.71	0.17	0.03	0.01	0.11	1.14	0.63
A_{23}	8″–$8\frac{3}{4}$″	0.40	0.026	1.0	36	----	6.25	1.73	0.32	0.05	0.01	----	----	----
B_{irh_1}	$8\frac{3}{4}$″–12″	1.25	0.064	1.5	54	48	12.20	2.90	0.36	0.07	0.03	0.60	2.93	0.90
B_{irh_2}	12″–21″	0.90	0.036	11.0	28	28	7.95	0.80	0.08	0.04	0.03	0.50	2.34	0.76
B_{irh_3}	21″–25″	0.38	0.017	37.5	22	20	4.04	0.67	0.04	0.03	0.07	----	----	----
B(m)	25″–46″	0.17	0.010	24.0	15	15	2.27	0.65	0.03	0.02	0.01	0.15	2.00	0.71
C_1	46″–54″	0.16	0.010	82.0	18	16	2.05	0.67	0.05	0.02	0.01	0.12	1.32	0.48
C_2	54″–59″	0.22	0.012	42.5	20	18	3.03	0.68	0.05	0.03	0.02	----	----	----
C_3	59″–64″	0.19	0.011	29.5	25	22	2.63	0.67	0.06	0.03	0.09	----	----	----
C_4	64″–72″	0.10	0.007	167.5	28	----	1.62	0.23	0.05	0.04	0.10	----	----	----
C_5	72″–78″	0.09	0.006	140.0	32	----	2.27	0.27	0.09	0.04	0.02	----	----	----
C_6	78″–84″	0.05	0.005	97.5	30	----	1.49	0.35	0.11	0.04	0.03	----	----	----
Cultivated soil														
A_p	0″–8″	1.04	0.068	8.5	126	382	4.50	2.35	0.60	0.16	0.03	0.18	----	----
A_2	8″–14″	0.13	0.011	2.0	24	75	1.48	0.50	0.24	0.03	0.01	0.10	----	----
B_{irh_1}	14″–23″	0.99	0.047	2.5	54	52	8.03	1.10	0.41	0.07	0.04	0.58	----	----
B_{irh_2}	23″–30″	0.64	0.032	12.0	22	17	6.45	0.62	0.40	0.03	0.01	0.31	----	----
B_{irh_3}	30″–40″	0.98	0.039	3.5	18	26	6.63	0.47	0.08	0.02	0.03	----	----	----
B(m)	40″–46″	0.21	0.011	52.5	15	12	2.38	0.20	0.02	0.02	0.08	0.11	----	----
C_1	46″–68″	0.11	0.007	69.0	12	16	1.15	0.20	0.04	0.02	0.08	0.13	----	----

TABLE XVI. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN

Stambaugh silt loam, shallow phase
(S. E.¼ Sec. 11, T. 40 N., R. 15 E.)

Horizon[1]	Depth Inches	pH Tg	pH Bk	BD	Particle size distribution analysis c %	fsi %	msi %	csi %	vfs %	fs %	ms %	cs %	vcs %	Texture
A_{oo}	2½–2	----	----	----	----	----	----	----	----	----	----	----	----	----
A_o	2–0	6.5	5.7	----	----	----	----	----	----	----	----	----	----	----
A_1	0–¼	----	5.1	----	----	----	----	----	----	----	----	----	----	si muck
A_2	¼–5	5.5	5.0	1.40	10	6	28	36	12	3	3	2	tr	sil
B_{irh1}	5–7½	5.0	4.8	1.09	18	5	19	32	17	5	2	2	tr	sil
B_{irh2}	7½–10½	5.0	5.0	1.16	14	4	22	35	13	5	5	2	tr	sil
A'_{2m}	10½–18½	5.0	4.9	1.92	10	6	9	23	19	14	12	7	tr	sil
B'_m	18½–22	5.0	5.1	1.86	15	4	8	16	20	14	13	9	1	f l
B_3	22–22½	5.5	5.3	1.47	4	0	1	0	6	52	35	2	tr	l
D_1	22½–33	6.2	5.7	1.68	3	0	0	0	6	50	37	4	tr	m s
D_2	33–36	----	7.6	1.91	4	0	0	0	2	14	32	39	9	cos and G

Fence loam
(N. W. ¼ S. E. ¼ Sec. 30, T. 38 N., R. 17 E.)

Horizon	Depth Inches	pH Tg	pH Bk	BD	c %	fsi %	msi %	csi %	vfs %	fs %	ms %	cs %	vcs %	Texture
A_{oo}	1–¾	----	----	----	----	----	----	----	----	----	----	----	----	----
A_o	¾–0	6.0	5.4	----	----	----	----	----	----	----	----	----	----	----
A_1	0–½	5.5	5.5	----	----	----	----	----	----	----	----	----	----	si-sil
A_2	½–5	4.7	4.7	1.29	9	5	15	27	21	12	8	3	tr	si-sil
B_{irh}	5–9½	4.3	4.6	1.10	15	5	14	19	24	13	7	3	tr	si-sil
B_{ir1}	9½–15	5.0	4.9	1.26	14	5	9	24	28	10	7	3	tr	si-sil
B_{ir2}	15–20	5.5	5.0	1.39	11	4	11	24	24	14	9	3	tr	si-sil
A'_2	20–25	5.3	5.0	1.68	12	2	6	19	24	19	12	6	tr	co si
B'_2	25–32	4.5	4.9	1.74	14	2	8	22	20	17	10	6	1	fsl
$C_1(D_1)$	32–37	5.5	5.2	1.66	5	0	0	0	5	55	27	8	tr	fs
$C_2(D_2)$	37–90	6.0	5.3	----	7	0	0	0	6	43	31	13	tr	s
$C_3(D_3)$	90–120	5.8	5.2	----	13	3	6	15	30	25	6	2	tr	ls-sl
$C_{rb}(D_{rb})$*	34,43	4.8	6.3	1.76	10	0	0	0	3	25	40	22	tr	si-sil
$C_{gb}(D_{gb})$**	50–55	5.0	5.8	----	7	1	1	0	20	50	17	4	tr	fs

[1] Subscript "(m)" signifies incipient fragipan.
*Red bands.
**Gray bands.

Stambaugh silt loam, shallow phase
(S. E. ¼ Sec. 11, T. 40, N., R. 15 E.)

Horizon	Depth Inches	C %	N %	N #/A	Avail P #/A	Avail K #/A	Dry K #/A	Wet K #/A	Avail P #/A	Bray P #/A
A_{oo}	2½–2	----	----	----	----	----	----	----	----	----
A_o	2–0	15.55	1.703	250	100	480	460+	300	170	120
A_1	0–¼	8.94	0.941	175	64	380	720	1350	135	115
A_2	¼–5	1.56	0.047	100	30	70	90	170	34	55
B_{irh1}	5–7½	5.27	0.133	175	23	120	90	90	44	24
B_{irh2}	7½–10½	3.41	0.080	150	14	65	145	135	32	12
A'_{2m}	10½–18½	1.46	0.016	75	168	75	90	65	62	22
B'_m	18½–22	1.14	0.012	50	160	135	120	95	77	19
B_3	22–22½	1.01	0.002	25	148	45	50	40	85	18
D_1	22½–33	0.92	0.006	25	140	30	40	35	85	12
D_2	33–36	1.01	0.004	25	120	50	55	50	120	7

TABLE XVI. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Fence silt loam
(N. W. ¼ S. E. ¼ Sec. 30, T. 38 N., R. 17 E.)

Horizon	Dpeth Inches	C %	N %	N #/A	Avail P #/A	Avail K #/A	Dry K #/A	Wet K #/A	Avail P #/A	BrayP #/A
A_{00}	1–¾	--------	--------	--------	--------	--------	--------	--------	--------	--------
A_0	¾–0	8.12	1.306	350	115	370	460+	300	160	110
A_1	0–½	8.23	0.521	300	60	330	460+	300	120	102
A_2	½–5	2.42	0.104	175	26	95	170	250	37	56
B_{irh}	5–9½	3.30	0.115	175	ex fe*	140	115	115	70	87
B_{ir1}	9½–15	1.79	0.067	125	36	90	80	80	75	70
B_{ir2}	15–20	1.50	0.060	100	39	75	75	70	65	77
A'_2	20–25	0.52	0.020	25	68	110	125	100	36	42
B'_2	25–32	0.33	0.016	25	16	170	165	150	15	24
$C_1(D_1)$	32–37	tr	0.009	25	120	60	60	45	110	32
$C_2(D_2)$	37–90	tr	0.012	25	120	120	65	80	73	22
$C_3(D_3)$	90–120	tr	0.014	25	250	150	100	85	250	20
$C_{rb}(D_{rb})$	34,43	0.18	0.014	25	45	120	130	125	0	39
$C_{gb}(D_{gb})$	50–55	tr	0.010	25	390	120	95	100	150	28

*Excess iron prevented analysis of available P.

Stambaugh silt loam, shallow phase
(S. E. ¼ Sec. 11, T. 40 N., R. 15 E.)

Horizon	Depth Inches	CEC	Exchangeable Cations				SiO_2 %	AL_2O_3 %	Fe_2O_3 %	Oven-dry roots/ 1 ft.²x1" gm
			Ca	Mg	K	Na				
			me/100 gm							
A_{oo}	2½–2	--------	--------	--------	--------	--------	--------	--------	--------	--------
A_o	2–0	--------	--------	--------	--------	--------	--------	--------	--------	104.8
A_1	0–¼	75.34	29.45	13.46	2.24	0.52	0.143	0.002	0.168	314.5
A_2	¼–5	6.42	2.30	0.16	0.10	0.14	0.056	0.000	0.838	32.2
B_{irh1}	5–7½	17.86	1.93	0.28	0.24	0.16	0.015	0.006	1.988	23.4
B_{irh2}	7½–10½	12.28	0.75	0.01	0.11	0.14	0.013	0.021	1.587	4.4
A'_{2m}	10½–18½	5.60	0.75	0.08	0.09	0.13	0.025	0.023	1.317	0.8
B'_m	18½–22	7.24	3.05	1.20	0.17	0.15	0.024	0.010	2.160	0.1
B_3	22–22½	2.66	1.00	0.28	0.06	0.12	0.058	0.021	1.496	0.1
D_1	22½–33	2.22	0.75	0.12	0.05	0.11	0.053	0.021	1.964	0.1
D_2	33–36	4.18	1.75	0.64	0.06	0.10	0.075	0.017	2.010	0.1

Fence silt loam
(N. W. ¼ S. E. ¼ Sec. 30, T. 38 N., R. 17 E.)

A_{oo}	1–¾	--------	--------	--------	--------	--------	--------	--------	--------	--------
A_o	¾–0	--------	--------	--------	--------	--------	--------	--------	--------	139.0
A_1	0–½	45.35	24.05	2.83	0.80	0.14	0.136	0.000	0.518	64.4
A_2	½–5	8.67	3.70	0.58	0.18	0.12	0.078	0.000	0.896	13.5
B_{irh}	5–9½	14.08	1.91	0.44	0.20	0.14	0.018	0.021	2.010	5.2
B_{ir1}	9½–15	8.32	0.80	0.26	0.14	0.13	0.048	0.035	1.374	2.9
B_{ir2}	15–20	7.38	2.60	0.26	0.12	0.14	0.023	0.025	1.049	0.5
A'_2	20–25	3.74	0.75	0.20	0.14	0.10	0.031	0.024	1.085	0.3
B'_2	25–32	4.46	1.15	0.43	0.21	0.14	0.051	0.030	1.314	0.2
$C_1(D_1)$	32–37	2.82	0.68	0.30	0.10	0.12	0.041	0.016	0.593	0.1
$C_2(D_2)$	37–90	2.38	0.68	0.32	0.09	0.11	0.048	0.018	0.518	tr
$C_3(D_3)$	90–120	5.48	1.70	0.74	0.21	0.06	0.039	0.008	1.274	--------
$C_{rb}(D_{rb})$	34,43	4.52	1.50	0.45	0.14	0.06	0.055	0.022	0.796	--------
$C_{gb}(D_{gb})$	50–55	3.28	1.20	0.26	0.09	0.05	0.060	0.023	1.053	--------

TABLE XVI. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Iron River silt loam
((N. W. ¼ N. W. ¼ Sec. 25, T. 40 N., R. 15 E.)

Horizon	Depth Inches	pH Tg	pH Bk	BD	Particle size distribution analysis c %	fsi %	msi %	csi %	vfs %	fs %	ms %	cs %	vcs %	Texture
A_{oo}	2-1	------	7.5	--------	----	----	----	----	----	----	----	----	----	-----------
A_o	1-0	5.0	5.8	--------	----	----	----	----	----	----	----	----	----	-----------
A_1	0-2	4.5	5.7	--------	----	----	----	----	----	----	----	----	----	sil
A_2	2-5	6.0	6.6	1.33	8	5	31	33	8	6	4	4	1	sil
B_1	5-9	5.5	5.5	1.32	14	4	21	36	12	4	4	4	1	sil
$B_2(B_m)$	9-12	6.0	4.7	1.48	13	4	20	35	14	5	4	4	1	sil
B_{m1}	12-17	5.8	5.4	1.69	13	5	15	30	15	9	6	6	1	sil
B_{m2}	17-23	5.3	5.2	1.86	13	2	6	8	7	19	22	19	4	sil-l
$C_1(D_1)$	23-26	5.7	5.4	1.76	10	2	5	3	6	15	20	32	7	l-sl
$C_2(D_2)$	26-40	6.3	5.7	1.88	10	2	0	0	4	17	26	36	5	sl-s

Superior loam
(N. E. ¼ N. W. ¼ Sec. 26, T. 40 N., R. 18 E.)

A_{oo}	½-0	-------	--------	--------	----	----	----	----	----	----	----	----	----	-----------
A_1	0-2	-------	5.3	1.16	7	5	12	15	13	31	12	4	1	sandy loam
A_2	2-5	6.3	5.2	1.28	7	5	11	17	14	30	11	4	5	gritty sandy loam
B_{irh}	5-13	6.8	5.3	1.24	11	9	14	11	16	22	11	5	1	sandy loam
B_{irh}-B_m	13-15	7.0	6.5	1.72	7	9	16	14	12	24	10	6	2	sandy loam
B_{m1}	15-17	7.0	5.3	1.91	10	8	18	8	14	23	12	6	1	sandy loam
B_{m2}	17-33	6.0	6.5	1.86	24	21	7	17	10	10	6	3	2	loam
(B_{m3})	33-40	6.7	-------	1.92	17	11	16	13	10	16	8	6	3	loam
$C_1(D_1)$	40-42	7.0	-------	1.89	17	11	14	12	12	16	8	7	3	loam
$C_2(D_2)$	42-45	7.3	-------	1.89	20	11	19	9	11	15	7	6	2	loam
$C_3(D_3)$	45-50	8.0	-------	1.91	16	10	14	12	19	16	7	4	2	loam
$C_4(D_4)$	50-55	8.0	-------	1.86	16	10	15	15	13	16	8	5	2	loam
$C_5(D_5)$	55-60	8.0	-------	1.87	16	12	17	17	11	15	6	4	2	loam
$C_6(D_6)$	60-71	*	-------	1.92	15	13	12	15	14	16	8	5	2	loam
$C_7(D_7)$	71-78	*	-------	--------	15	14	15	19	13	15	5	3	1	loam
$C_8(D_8)$	78-94	*	-------	--------	15	10	13	16	20	14	7	3	2	loam

*Effervesced with HCl acid.

Iron River silt loam
(N. W. ¼ N. W. ¼ Sec. 35, T. 40 N., R. 15 E.)

Horizon	Depth Inches	C %	N %	N #/A	Avail P #/A	Avail K #/A	Dry K #/A	Wet K #/A	Avail P #/A	Bray P #/A
A_{oo}	2-1	8.70	1.760	225	120	600	810	210	450	110
A_o	1-0	8.82	1.700	475	190	710	1300	440	500	110
A_1	0-2	8.41	0.639	400	53	330	470	240	110	87
A_2	2-5	2.34	0.094	175	36	110	160	195	43	58
B_1	5-9	1.54	0.066	150	54	120	130	160	73	110
$B_2(B_{m1})$	9-12	0.62	0.040	100	40	90	80	85	160	125
B_{m1}	12-17	0.47	0.022	75	37	130	100	75	150	84
B_{m2}	17-23	0.21	0.014	50	78	90	135	105	100	40
$C_1(D_1)$	23-26	tr	0.012	25	156	85	110	85	105	39
$C_2(D_2)$	26-40	tr	0.007	25	85	65	90	70	130	11

TABLE XVI. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Superior loam
(N. E. ¼ N. W. ¼ Sec. 26, T. 40 N., R. 18 E.)

Horizon	Depth Inches	C %	N %	N #/A	Avail P #/A	Avail K #/A	Dry K #/A	Wet K #/A	Avail P #/A	Bray P #/A
A_{oo}	½–0	------	------	------	------	------	------	------	------	------
A_1	0–2	7.68	0.246	275	57	180	145	275	50	62
A_2	2–5	3.94	0.128	175	45	80	40	55	13	34
B_{irh}	5–13	2.34	0.067	150	40	80	45	50	85	62
B_{irh}-B_m	13–15	0.64	0.023	75	115	80	65	60	110	12
B_{m1}	15–17	0.41	0.019	50	130	85	145	115	250	16
B_{m2}	17–33	0.33	0.025	25	140	135	140	70	300	5
(B_{m3})	33–40	0.31	0.017	25	140	120	------	------	------	------
$C_1(D_1)$	40–42	0.41	0.011	25	55	130	------	------	------	------
$C_2(D_2)$	42–45	0.23	0.013	25	75	130	------	------	------	------
$C_3(D_3)$	45–50	0.58	0.015	25	160	110	------	------	------	------
$C_4(D_4)$	50–55	0.37	0.017	25	125	110	------	------	------	------
$C_5(D_5)$	55–60	0.25	0.008	25—	115	120	------	------	------	------
$C_6(D_6)$	60–71	0.37	0.013	25—	170	120	------	------	------	------
$C_7(D_7)$	71–78	0.25	0.019	25—	8	110	------	------	------	------
$C_8(D_8)$	78–94	0.43	0.007	25—	1	115	------	------	------	------

Iron River silt loam
(N. W. ¼ N. W. ¼ Sec. 35, T. 40 N., R. 15 E.)

Horizon	Depth Inches	CEC	Exchangeable Cations				Mobile SiO_2 %	Exchangeable Al_2O_3 %	Reductant soluble FE_2O_3 %	Oven-dry roots/ ft.^{2}x1" gm
			Ca	Mg	K	Na				
			me/100 gm							
A_{oo}	2–1	------	------	------	------	------	------	------	------	------
A_o	1–0	------	------	------	------	------	------	------	------	92.0
A_1	0–2	35.24	13.80	2.63	0.91	0.13	0.375	0.000	0.703	73.0
A_2	2–5	8.78	2.78	0.71	0.18	0.12	0.124	0.000	0.875	22.5
B_1	5–9	10.04	2.30	0.51	0.20	0.14	0.046	0.015	1.692	8.2
$B_2(B_m)$	9–12	7.38	1.50	0.35	0.16	0.12	0.068	0.027	1.503	2.4
B_{m1}	12–17	7.38	2.55	0.60	0.19	0.13	0.061	0.025	1.685	0.3
B_{m2}	17–23	5.44	2.15	0.48	0.13	0.12	0.072	0.023	1.606	0.2
$C_1(D_1)$	23–26	4.51	1.72	0.42	0.10	0.10	0.058	0.016	1.346	tr
$C_2(D_2)$	26–40	4.01	1.65	0.46	0.09	0.12	0.064	0.015	1.480	1.3

Superior loam
(N. E. ¼ N. W. ¼ Sec. 26, T. 40 N., R. 18 E.)

A_{oo}	½–0	------	------	------	------	------	------	------	------	------
A_1	0–2	19.54	11.20	1.40	0.24	0.14	0.152	0.000	.939	24.4
A_2	2–5	13.60	7.50	0.68	0.08	0.12	0.081	0.002	1.139	3.5
B_{irh}	5–13	10.86	4.68	0.60	0.10	0.12	0.041	0.030	1.374	4.2
B_{irh}-B_m	13–15	5.22	1.30	0.38	0.09	0.13	0.048	0.027	1.096	0.3
B_{m1}	15–17	4.50	0.85	0.40	0.08	0.12	0.049	0.029	1.092	2.0
B_{m2}	17–33	11.74	4.30	3.22	0.20	0.16	0.061	0.007	1.864	4.2
(B_{m3})	33–40	12.98	4.55	3.42	0.15	0.18	0.075	0.006	1.646	------
$C_1(D_1)$	40–42	15.04	5.48	4.26	0.18	0.18	0.070	0.000	1.703	------
$C_2(D_2)$	42–45	13.62	5.86	4.40	0.18	0.18	0.081	0.000	1.692	------
$C_3(D_3)$	45–50	13.46	5.75	5.46	0.15	0.09	0.073	0.000	1.467	------
$C_4(D_4)$	50–55	12.30	5.62	4.78	0.15	0.09	0.070	0.000	1.507	------
$C_5(D_5)$	55–60	10.02	5.38	4.31	0.15	0.08	0.084	0.000	1.385	------
$C_6(D_6)$	60–71	11.38	7.00	5.26	0.18	0.08	0.082	0.000	1.489	------
$C_7(D_7)$	71–78	10.15	13.35	3.62	0.15	0.07	0.076	0.000	1.274	------
$C_8(D_8)$	78–94	8.69	8.45	4.28	0.16	0.07	0.081	0.000	1.146	------

TABLE XVI. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Fence silt loam
(S. E. ¼ Sec. 11, T. 40 N., R. 15 E.)

Horizon	Depth Inches	pH Tg	pH Bk	BD	Particle size distribution analysis: C %	fsi %	msi %	csi %	vfs %	fs %	ms %	cs %	vcs %	Texture
A_{oo}	½–⅛	----	----	----	----	----	----	----	----	----	----	----	----	----
A_o	⅛–0	----	----	----	----	----	----	----	----	----	----	----	----	----
A_1	0–1	5.7	----	----	----	----	----	----	----	----	----	----	----	sil
B_{hir}	1–7	5.4	5.3	1.34	10	6	33	32	13	1	4	1	tr	sil
B_{ir}	7–10	5.5	----	----	----	----	----	----	----	----	----	----	----	sil
A'_{2m}	10–12	5.4	5.3	1.49	7	2	28	37	13	5	6	2	tr	sil
B'_{2m}	12–22	5.3	5.0	1.62	15	9	23	33	13	3	3	1	tr	sil
A''_{2m}*	22–27	5.4	5.2	1.54	10	8	26	39	13	1	2	1	tr	sil
B''_{2m}*	27–36	5.3	5.0	1.59	12	6	22	31	17	4	6	1	1	sil-co sil
C_{1m}	36–40	5.3	4.9	1.61	13	5	24	38	15	2	2	1	tr	vfsl
C_{2t}	40–56	5.3	5.0	1.53	7	6	26	43	16	1	1	tr	tr	hvy sil
C_3	56–63	5.4	4.9	1.63	10	5	18	26	23	6	8	3	1	hvy sil
C_4	63–82	5.5	5.0	1.73	10	6	12	22	18	12	16	3	1	scl
D	82–90	5.7	5.5	1.47	5	4	2	2	5	22	47	10	3	gr ls

*The A''_{2m} is an irregular extension of the A'_{2m} into the B_m horizon. Therefore the A'_{2m} and A''_{2m} are parts of one and the same horizon. Likewise the B'_{2m} and B''_{2m} are parts of one and the same horizon.

Fence silt loam
(S. E. ¼ Sec. 11, T. 40 N., R. 15 E.)

Horizon	Depth Inches	% C %	% N %	N #/A	Avail P #/A	Avail K #/A	Dry K #/A	Wet K #/A	Avail P #/A	Bray P #/A
A_{oo}	½–⅛	----	----	----	----	----	----	----	----	----
A_o	⅛–0	----	----	----	----	----	----	----	----	----
A_1	0–1	----	----	----	----	----	----	----	----	----
B_{hir}	1–7	1.11	0.070	135	48	75	----	----	----	----
B_{ir}	7–10	----	----	----	----	----	----	----	----	----
A'_{2m}	10–12	0.36	0.020	60	15	75	----	----	----	----
B'_{2m}	12–22	0.23	0.018	56	24	215	----	----	----	----
A''_{2m}	22–27	0.20	0.020	52	19	180	----	----	----	----
B''_{2m}	27–36	0.14	0.016	38	25	165	----	----	----	----
C_{1m}	36–40	0.16	0.014	30	24	140	----	----	----	----
C_{2t}	40–56	0.13	0.017	38	24	110	----	----	----	----
C_3	56–63	0.15	0.019	38	20	115	----	----	----	----
C_4	63–82	0.10	0.010	38	17	140	----	----	----	----
D_{ϵ}	82–90	0.11	0.010	26	16	90	----	----	----	----

Fence silt loam
(S. E. ¼ Sec. 11, T. 40 N., R. 15 E.)

Horizon	Depth Inches	CEC	Exchangeable Cations (me/100 gm): Ca	Mg	K	Na	Mobile SiO_2 %	Exchangeable Al_2O_3 %	Reductant soluble Fe_2O_3 %	Oven-dry roots/ft.²x1" gm
A_{oo}	½–⅛	----	----	----	----	----	----	----	----	----
A_o	⅛–0	----	----	----	----	----	----	----	----	----
A_1	0–1	----	----	----	----	----	----	----	----	----
B_{hir}	1–7	8.94	1.35	0.30	0.13	0.11	0.036	0.033	1.221	----
B_{ir}	7–10	----	----	----	----	----	----	----	----	----
A'_{2m}	10–12	6.01	1.00	0.35	0.12	0.12	0.040	0.034	1.182	----
B'_{2m}	12–22	10.35	2.95	1.34	0.36	0.12	0.025	0.022	2.081	----
A''_{2m}	22–27	10.24	3.35	1.29	0.28	0.09	0.035	0.019	1.642	----
B''_{2m}	27–36	11.50	4.05	1.53	0.25	0.12	0.042	0.014	2.063	----
C_{1m}	36–40	10.57	4.16	1.58	0.22	0.08	0.043	0.015	1.407	----
C_{2t}	40–56	9.39	3.80	1.49	0.18	0.08	0.051	0.015	1.560	----
C_3	56–63	9.52	3.68	1.50	0.18	0.07	0.074	0.017	1.785	----
C_4	63–82	8.36	3.58	1.48	0.20	0.08	0.061	----	----	----
D	82–90	4.74	1.42	0.59	0.11	0.05	0.052	----	----	----

TABLE XVII. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN

Horizon	Depth	pH	B.D.	Particle size distribution c	fsi	msi	csi	vfs	fs	ms	cs	vcs	Texture	Organic Matter	Avail. K Dry	Avail. K Wet	Avil. P
	Inches	BK		%	%	%	%	%	%	%	%	%		%	lbs/a	lbs/a	lbs/a
AHMEEK LOAM, DEEP (N. W. ¼ S. W. ¼ Sec. 34, T. 40 N., R. 18 E.)																	
A_1	0–3	5.4		15	8	16	14	10	19	8	7	3	l	6.00			
A_2	3–4	5.4											gr l				
B	4–14	5.7		14	5	17	12	14	15	10	8	5	gr l	0.67			
B_{m1}	14–24	5.4		12	7	15	14	9	21	10	8	4	gr l	0.17			
B_{m2}	24–30	5.7		15	5	13	9	11	24	12	7	4	sl	0.34			
B_{m3}	30–35	6.0		12	1	14	10	10	28	14	7	4	sl	0.17			
C_1	35–42	5.7		13	1	6	11	8	36	15	6	4	st sl	0.02			
D	42–48	5.9		23	8	13	19	7	12	6	8	4	l	0.08			
BRULE SILT LOAM (S. E. ¼ S. E. ¼ Sec. 3, T. 38 N., R. 19 E.)																	
A	0–6	7.0		8	6	20	18	21	22	3	2	tr	l				
AB	6–12	6.4		8	8	12	4	24	43	1	tr	tr	sl				
C_1	12–21	6.6		8	4	5	3	30	50	tr			ls				
C_2	21–28	6.8		10	11	13	7	30	28	1			sl				
C_3	28–42	6.8		8	5	5	11	27	44	tr			sl				
C_4	42–54	6.8											sl				
CABLE SILT LOAM (N. W. ¼ Sec. 26, T. 40 N., R. 17 E.)																	
A_1	0–5	6.7											sil		80	95	450
A_{2g}	5–10	5.6											sil		60	55	48
C_{1g}	10–14	5.2											fsl		55	55	87
C_{2g}	14–24	5.4											fsl		50	65	100
C_{3g}	24–30	5.0											m sl		50	40	100
CRIVITZ SANDY LOAM (S. E. ¼ N. W. ¼ Sec. 19, T. 38 N., R. 16 E.)																	
A_0	½–0												H				
A_1	0–1	5.1											sl		245	135	15
A_2	1–4	4.9											sl		145	70	21
B_{irh_1}	4–5½	4.6											vfsl		75	70	28
B_{irh_2}	5½–12	5.1											fsl		60	60	28
A'_{2m}	12–16	5.3											sl		40	40	19
B'_{21m}	16–21	5.4											sl		60	60	7
B'_{22m}	21–23	5.2											sl		60	60	5
C_1	23–33	5.9											s		30	30	70
C_2	33–44	6.2											s		55	45	65

TABLE XVII. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Horizon	Depth	pH	B.D.	Particle size distribution									Texture	Organic Matter	Avail. K		Avil. P
				c	fsi	msi	csi	vfs	fs	ms	cs	vcs			Dry	Wet	
	Inches	BK		%	%	%	%	%	%	%	%	%		%	lbs/a	lbs/a	lbs/a
GOODMAN SILT LOAM (S. E. ¼ S. E. ¼ Sec. 23, T. 40 N., R. 15 E.)																	
A_2	0- 3	6.0	1.02	15	6	29	39	9	1	1	tr	tr	si l	1.60			
B_{irh_1}	3- 6	5.7	1.11	16	8	26	38	11	1	tr	tr	tr	si l	1.60			
B_{irh_2}	6-11	5.7	1.22	12	5	30	44	7	1	1	tr	tr	si l	0.88			
B_{m1}	11-28	5.5	1.46	15	3	7	3	7	14	20	24	7	st sl	0.53			
B_{m2}	28-30	5.5											l	0.53			
C	30-36	5.5												0.08			
GOODMAN SILT LOAM (S. W. ¼ S. E. ¼ Sec. 17, T. 39 N., R. 17 E.)																	
A_{oo}	2- 1	6.3											L		185	840	160
A_o	1- 0	5.3											H		265	400	100
A_1	0- 1	4.6											si l		245	180	60
A_2	1-2½	4.4											sil		90	70	42
B_{irh_1}	2½- 6	4.7											sil		60	65	32
B_{irh_2}	6-12	4.9											sil		40	40	30
A'_{2m}	12-19	5.7											sil		40	60	43
B'_{2m}	19-26	6.5											sil		75	90	60
C	26-32	6.1											gr sil		85	120	70
HIBBING LOAM (S. W. ¼ N. W. ¼ Sec. 15, T. 39 N., R. 18 E.)																	
A_1	0- 2	5.9	0.97	24	12	19	14	7	12	6	4	2	l	5.20			
A_1-A_2	2- 4	6.1															
A_2	4-5½	6.1	1.61	13	9	19	20	16	12	7	5	1	l	0.60			
A_2-B	5½-8½	5.7		17	7	25	18	11	12	6	3	1	sil				
B_2	8½-16	5.5	1.55	25	11	22	5	7	12	11	7	tr	c l	0.25			
C_1	16-26	6.5	1.52	40	15	27	4	1	7	3	2	1	si c	0.08			
C_3	60-65	8.5		34	19	21	8	3	6	3	3	3	si cl				
IRON RIVER SANDY LOAM (N. W. ¼ N. W. ¼ Sec. 24, T. 38 N., R. 19 E.)																	
A_p	0- 6	5.5		10	7	14	15	20	11	7	10	6	sl				
B_{irh}	6-14	5.9		10	8	17	12	25	10	6	9	3	sl				
A'_{2m}	14-18	6.0															
B'_{2m}	18-22	6.0		8	7	6	1	12	16	16	21	13	G sl				
C	22-28	6.3		8	6	3	2	4	10	12	28	27	G ls				
D	28-60	6.5		2	0	0	0	2	3	16	35	42	G co_3				

TABLE XVII. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Horizon	Depth	pH	B.D.	Particle size distribution									Texture	Organic Matter	Avail. K		Avil. P
				c	fsi	msi	csi	vfs	fs	ms	cs	vcs			Dry	Wet	
	Inches	BK		%	%	%	%	%	%	%	%	%		%	lbs/a	lbs/a	lbs/a
LINWOOD MUCK (S. E. ¼ Sec. 28, T. 41 N., R. 16 E.)																	
O_1	0– 6	5.1											Mu		40	175	19
O_2	6–14	5.2											Pe Mu		20	80	20
O_3	14–24	3.9											Mu Pe		15	45	8
O_4	24–30	2.5											Pe		28	40	8
D_g	30–34	3.9											fsl		40	50	140
MOYE SANDY LOAM (Center Sec. 5, T. 38 N., R. 17 E.)																	
A_{oo}, A_o	1– 0	6.0											L & H		1730	1290	100
A_{21}	0– 2	4.4											sl		145	105	36
A_{22}	2– 7	4.1											sl		85	70	7
B_{irh_1}	7–10	4.8											ls		60	65	450
B_{irh_2}	10–16	4.7											ls		35	25	200
B_{m1}	16–23	5.1											vfsl		20	30	90
B_{m2}	23–36	5.8											lfs		25	20	38
C	36–60	5.3											fs		55	70	130
PENCE SANDY LOAM (N. E. ¼ N. W. ¼ Sec. 29, T. 40 N., R. 19 E.)																	
A_2	0– 2	5.2		6	3	17	18	13	10	18	15	tr	sl				
B_{irh1}	2– 6	5.2		5	7	13	19	12	10	18	15	1	sl				
B_{irh2}	6–20	5.3		7	3	11	19	13	12	18	16	1	sl				
B_m	20–24	5.3		4	2	7	12	8	15	26	24	2	ls			40	10
C_1	24–30	5.4		0	0	0	0	2	26	63	9	tr	ms			30	11
C_2	30–36	6.0											ms			25	89
C_3	36–42	5.6											ms			35	66
C_4	42–48	6.1											ms			20	108
C_5	52–60	6.0		0	0	0	0	tr	14	51	28	7	m-cs				
STAMBAUGH SILT LOAM (Center N. W. ½ Sec. 30, T. 40 N., R. 15 E.)																	
A_o	2– 0												H				
A_2	0– 6	6.5	1.09	14	14	24	33	8	2	2	3	tr	sil	2.6			
B_{irh}	6–12	5.5	1.07										sil	1.7			
B_{21m}	12–17	5.5	1.24	14	6	21	40	11	2	2	3	1	sil	1.3			
B_{22m}	17–24	5.5	1.63	18	7	20	32	15	1	4	2	1	sil	1.9			
B_{23}	24–40	5.5	1.57	21	8	16	32	13	2	3	3	2	gr sil	1.6			
D	42–48	6.0	1.61										s	0.3			

TABLE XVII. ANALYTICAL DATA FOR SOME SOILS OF FLORENCE COUNTY, WISCONSIN—Continued

Horizon	Depth	pH	B.D.	Particle size distribution									Texture	Organic Matter	Avail. K		Avil. P
				c	fsi	msi	csi	vfs	fs	ms	cs	vcs			Dry	Wet	
	Inches	BK		%	%	%	%	%	%	%	%	%		%	lbs/a	lbs/a	lbs/a
VILAS LOAMY SAND (Center N. E. ¼ Sec. 18, T. 40 N., R. 17 E.)																	
A_1	0- 1	5.2	---	---	---	---	---	---	---	---	---	---	ls	3.40	---	90	14
A_2	1- 4	5.4	1.37	10	0	1	3	4	37	30	13	2	ls	0.84	---	---	---
B_{irh}	4- 7	5.1	1.25	5	1	3	3	10	42	29	7	tr	s	1.20	---	18	7
B_{ir}	7-26	5.5	1.43	6	0	3	4	8	43	27	9	tr	s	0.55	---	15	29
B_3	26-32	5.3	1.47	4	0	1	1	6	33	39	14	2	s	0.12	---	32	83
C_1	32-36	5.5	1.53	2	0	1	2	4	42	36	13	tr	s	0.07	---	12	17
C_2	36-42	5.5	---	---	---	---	---	---	---	---	---	---	s	---	---	9	96
C_3	42-48	5.6	---	---	---	---	---	---	---	---	---	---	s	---	---	13	66
WAKEFIELD LOAM (N. E. ¼ N. W. ¼ Sec. 33, T. 40 N., R. 17 E.)																	
A_2	0- 3	4.9	---	16	5	20	15	8	16	11	7	2	l	2.30	---	75	10
B_{irh1}	3- 7	5.0	---	18	8	18	14	6	15	9	8	4	l	3.20	---	90	8
B_{irh2}	7-14	4.9	---	19	7	24	12	8	11	8	7	4	l	2.60	---	60	9
B_m	14-18	5.2	---	19	9	21	13	7	14	6	7	4	gr l	1.00	---	80	30
C_1	18-24	5.3	---	27	9	20	10	7	15	6	5	1	cl	0.55	---	105	59
C_2	24-30	5.7	---	---	---	---	---	---	---	---	---	---	si cl	---	---	105	96
C_3	30-36	6.2	---	---	---	---	---	---	---	---	---	---	si cl	---	---	95	175
C_4	36-42	5.5	---	---	---	---	---	---	---	---	---	---	si cl	---	---	110	122
C_5	42-48	5.6	---	---	---	---	---	---	---	---	---	---	si cl	---	---	105	240

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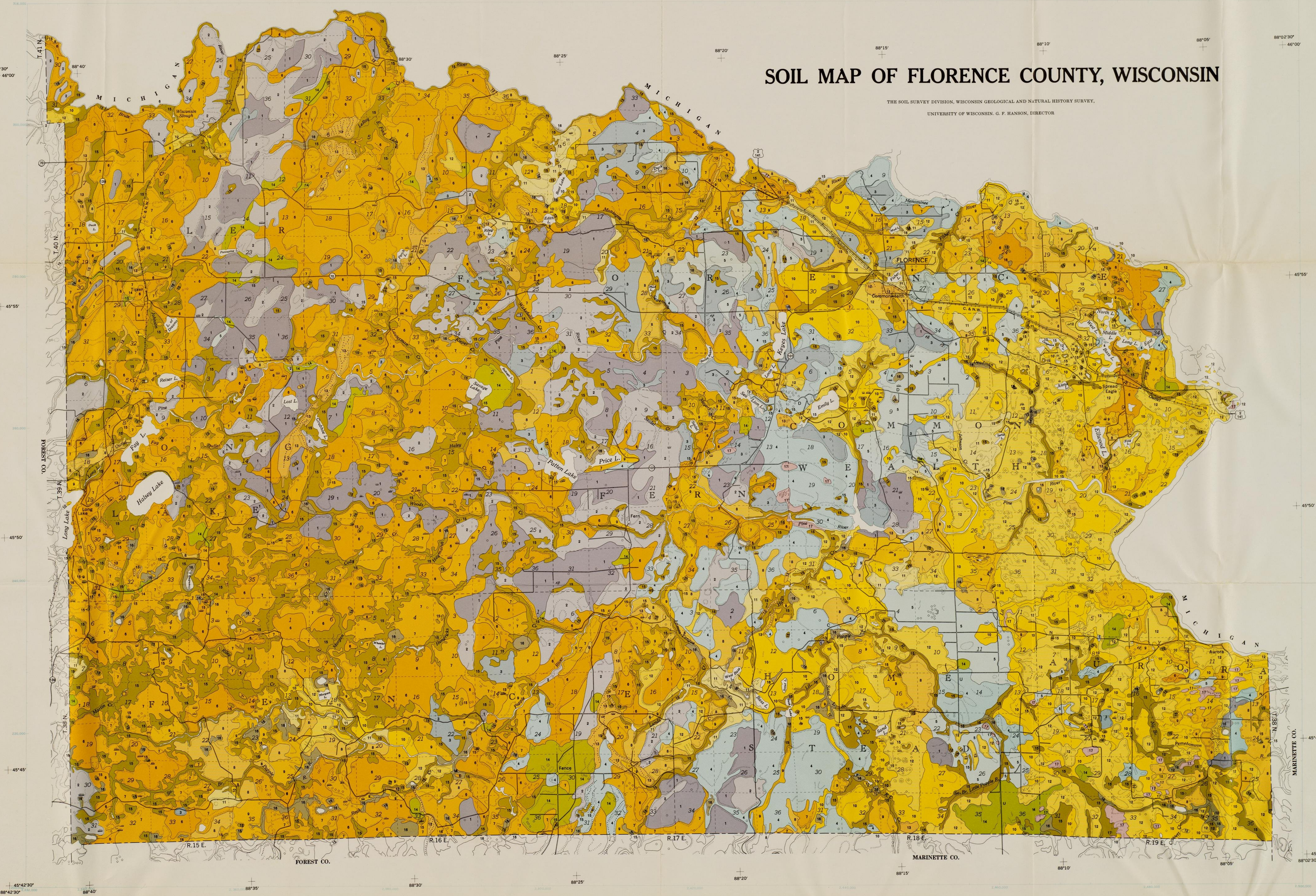
SOIL MAP OF FLORENCE COUNTY, WISCONSIN

THE SOIL SURVEY DIVISION, WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY,
UNIVERSITY OF WISCONSIN. G. F. HANSON, DIRECTOR



SOILS LEGEND

SOILS OF THE GLACIAL TILL UPLANDS

SOILS FORMED FROM SILTY TO LOAMY DEPOSITS OVERLYING REDDISH-BROWN ACID SANDY LOAM TO CLAY LOAM GLACIAL DRIFT, LARGELY TILL

1 Goodman and associated soils, nearly level to undulating

2 Goodman and associated soils, rolling to hilly

3 Wakefield, Ahmeek and associated soils, nearly level to hilly

4 Iron River, Pence and associated soils, nearly level to hilly

SOILS FORMED FROM CALCAREOUS, REDDISH-BROWN CLAY LOAM AND SILTY CLAY LOAM GLACIAL DRIFT, LARGELY TILL, WITH LOCAL SANDY COVERING

5 Hibbing, Ubly and associated soils, nearly level to rolling

SOILS OF THE GLACIO-FLUVIAL UPLANDS

SOILS FORMED FROM SILTY OR LOAMY DEPOSITS OVER OUTWASH SAND AND GRAVEL

6 Stambaugh and associated soils, nearly level to undulating

7 Stambaugh and associated soils, rolling to hilly

8 Pence, Stambaugh and associated soils, nearly level to undulating,

9 Pence, Stambaugh and associated soils, rolling to hilly

SOILS FORMED FROM SANDY DEPOSITS OVER GLACIAL DRIFT, LARGELY OUTWASH SAND

10 Vilas, Pence and associated soils, nearly level to undulating

11 Vilas and associated soils, rolling to hilly

12 Vilas, Pence and associated soils, rolling to hilly

SOILS FORMED FROM STONY, GRAVELLY AND SANDY GLACIAL DRIFT, LARGELY OUTWASH

13 Emmert, Vilas and associated soils, rolling to hilly

SOILS OF THE GLACIO-LACUSTRINE BASINS

SOILS FORMED FROM DEEP SILTY AND FINE SANDY GLACIO-LACUSTRINE AND INWASH SEDIMENTS

14 Fence and associated soils nearly level to undulating

SOILS FORMED LARGELY FROM ORGANIC MATERIALS

15 Peat, muck and associated soils, nearly level to gently sloping, with forest cover

16 Peat, muck and associated soils, nearly level to gently sloping, without forest cover

"GRANITIC" ROCKLAND

17 "Granitic" rockland and associated soils

Soil Survey, 1958-1961 by the Soil Survey Division, Wisconsin Geological and Natural History Survey, University of Wisconsin in cooperation with the Soils Department, College of Agriculture, University of Wisconsin, and the Soil Conservation Service of the United States Department of Agriculture. Publication by the Soil Survey Division, Wisconsin Geological and Natural History Survey. Soil Survey by Gerald W. Olson, Clarence J. Milfred, Keith O. Schmude, James F. Krueger and Francis D. Hole. Reference was made by permission to some farm soil maps of H. V. Strelow of the Soil Conservation Service. Land form and surface drainage map compiled by F. D. Hole from aerial photographs dated July, 1951. Cartography by R. D. Sale and Rodney Helgeland.

LAMBERT CONFORMAL PROJECTION 4000-FOOT GRID (INDICATED IN BLUE)
BASED ON WISCONSIN COORDINATE SYSTEM, NORTH ZONE

SCALE IN MILES

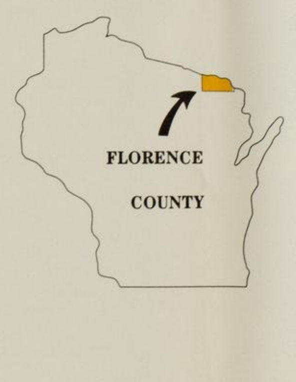
0 .5 1 2 3 4

MAP SIGNS

- County boundary
- Town line
- Section line
- Railroad
- Powerline
- Permanent stream
- Intermittent stream
- Lake
- Soil boundary
- Steep slopes
- Natural pit ("kettle")
- Esker
- Stones
- Rock outcrop
- Gravel pit or quarry
- Village

Roads and Highways

- U.S. highway
- State highway
- County highway
- Village road



WISCONSIN SOIL MAPS AND REPORTS

- ______ Leaflet colored soil map (state) _____Free
- ______ Technical bulletin on "Preliminary Study of the Profiles of the Principal Soil Types of Wisconsin __________ 25¢
- ______ Introduction to the Soils of Wisconsin 10¢
- ______ What's in that soil map? __________ 5¢

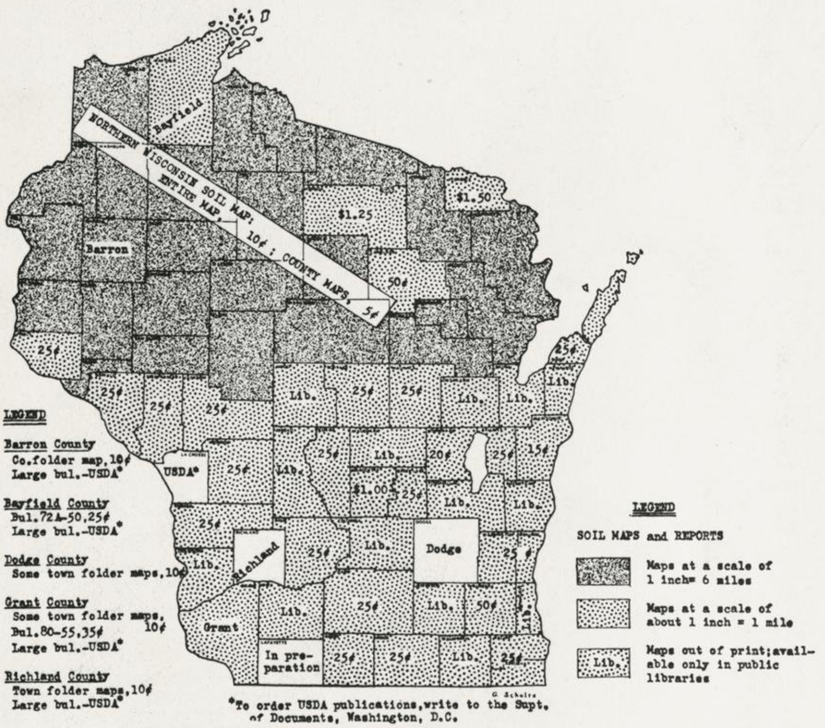


Figure 50. Index maps to soil survey publications by the Wisconsin Geological and Natural History Survey as of 1961. Requisitions and payments for the publications are handled by the Soil Survey Division, 203 Soils Building, University of Wisconsin, Madison 6, Wisconsin.