Geomorphic Processes

15-GEO-504

List and Brief Description of Symbols used to Designate Soil Horizons

(From G.W. Olson, 1976 adapted from Soil Survey Staff, 1962)

Master Horizon's

01	- -	Organic, undecomposed horizon
02	- -	Organic, decomposed horizon
Al	- -	Organic accumulation in mineral soil horizon
A2	- -	Leached, bleached horizon (eluviated)
A3	- -	Transition to B
AB	- -	Transition horizon A and B -- more like A in upper part
A and B	- -	A2 with less than 50% of horizon occupied by spots of B
AC	- -	Transition horizon, not dominated by either A or C
B	- -	Horizon with accumulation of clay, iron, cations, humus; residual concentration of clay; coatings; or alterations of original material forming clay and structures
B1	- -	Transition horizon, more like B than A
B and A	- -	B with less than 50% of horizon occupied by spots of A2
B2	- -	Maximum expression of B
B3	- -	Transitional horizon to C or R
C	- -	Altered material from which A and B horizons are presumed to have formed
R	- -	Consolidated bedrock

Subordinate Symbols

b	- -	Buried horizon
ca	- -	Calcium in horizon
cs	- -	Gypsum in horizon
cn	- -	Concretions in horizon
f	- -	Frozen horizon
9	- -	Gleyed in horizon
h	- -	Humus in horizon
ir	- -	Iron accumulation in horizon
m	- -	Cemented horizon
p	- -	Plowed horizon
sa	- -	Salt accumulation in horizon
si	- -	Silica cemented horizon
t	- -	Clay accumulation in horizon
x	- -	Fragipan horizon
II, III, IV	- -	Lithologic discontinuities
A'2, B'2	- -	Second sequence in bisequal soil

1. Mottling
   - a. Abundance
     - Few --Less than 20%
     - Common -- 2-20%
     - Many--More than 20%
   - b. Size
     - Fine--less than 5mm
     - Medium--5-15mm
     - Coarse--More than 15mm
   - c. Contrast
     - Faint
     - Distinct
     - Prominent

2. Textures

Sands - - Coarse sand, sand, fine sand, very fine sand
Loamy sands - - Loamy coarse sand, loamy sand, loamy fine sand
Sandy loams - - Sandy loam, fine sandy loam, very fine sandy loam

Silt	Silty clay loam	Silty clay
Silt loam	Clay loam	Clay
Loam	Sandy clay loam	Sandy clay

Adjectives -- Gravelly, cobbly, channery, flaggy, stony may apply to any of these

3. Structure

a. Class -- Size in mm

	Prisms	Blocks	Plates and granules
Very fine (very thin)	0-10	0-5	0-1
Fine (thin)	10-20	5-10	1 -2
Medium	20-50	10-20	2-5
Coarse (thick)	50-100	20-50	5-10
Very coarse (very thick)	100+	50+	10 +

b. Grade -- Distinctness

Structureless
Very weak
Weak
Moderate
Strong
Very strong

c. Type -- Form
Prismatic, Columnar
Blocky, Angular blocky, Subangular blocky
Granular, Crumb
Platy

4. Consistency

a. Dry	b. Moist	c. Wet	
Loose	Loose	Nonsticky	Nonplastic
Soft	Very friable	Slightly sticky	Slightly plastic
Slightly hard	Friable	Sticky	Plastic
Hard	Firm	Very sticky	Very plastic
Very hard	Very firm		
Extremely hard	Extremely firm		

5. Boundary

a. Distinctness	b. Topography
Abrupt 0-1 in	Smooth -- Nearly a plane
Clear 1-2.5 in	Wavy or undulating -- Pockets wider than deep
Gradual 2.5-5 in	Irregular -- Pockets deeper than wide
Diffuse >5 in	Broken -- Parts unconnected

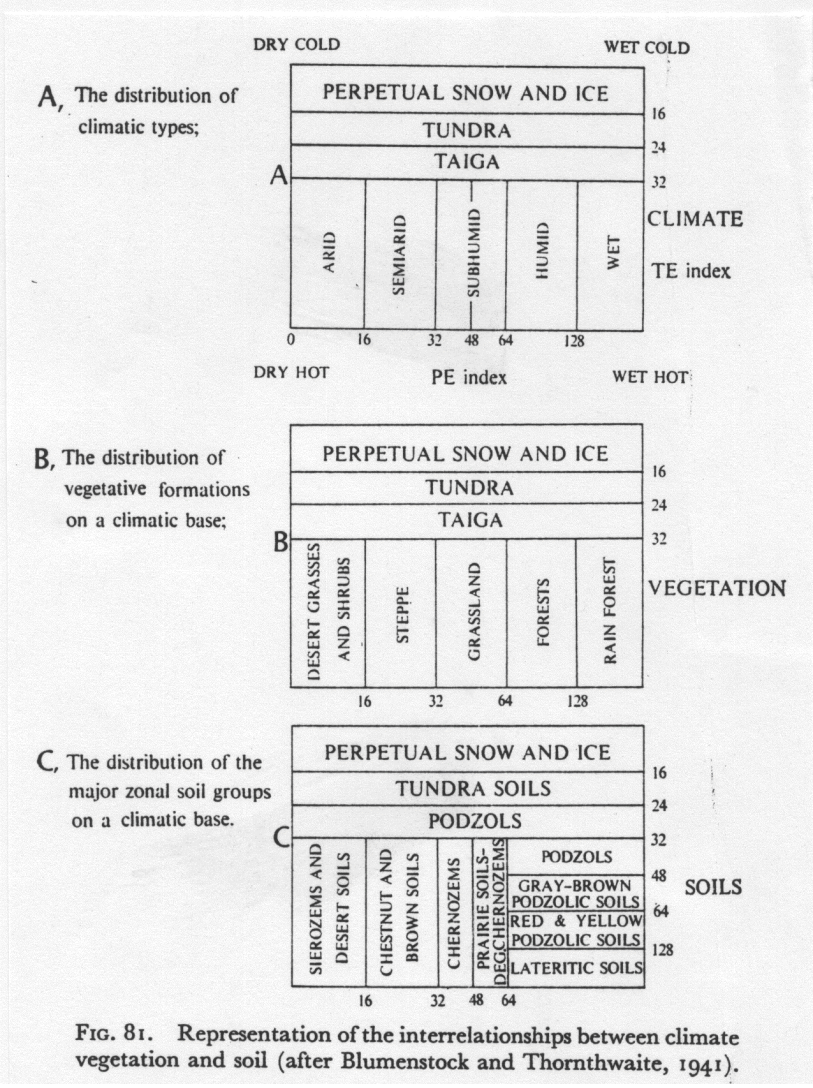

FIG. 81. Representation of the interrelationships between climate vegetation and soil (after Blumenstock and Thornthwaite, 1941).

Ollier, C.D. 1975. *Weathering.* London: Longman. p. 159.

$$PE = 115 \times \sum_{i=1}^{12} \left(\frac{P_i}{T_i - 10}\right)^{1.11}$$

$$TE = \frac{\left(\sum_{i=1}^{12} T_i - 32\right)}{4}$$

P_i = Monthly precipitation in inches during the *ith* month
T_i = Monthly mean temperature (OF) during the *ith* month

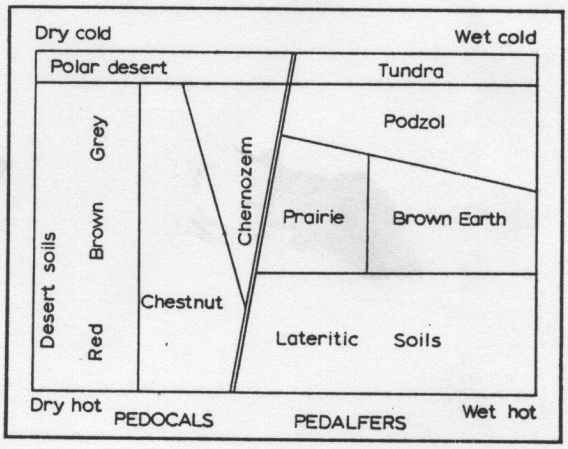

FIG. 78. Climatic relationships of the zonal soils.

Ollier, C.D. 1975. *Weathering.* London: Longman. p. 147.

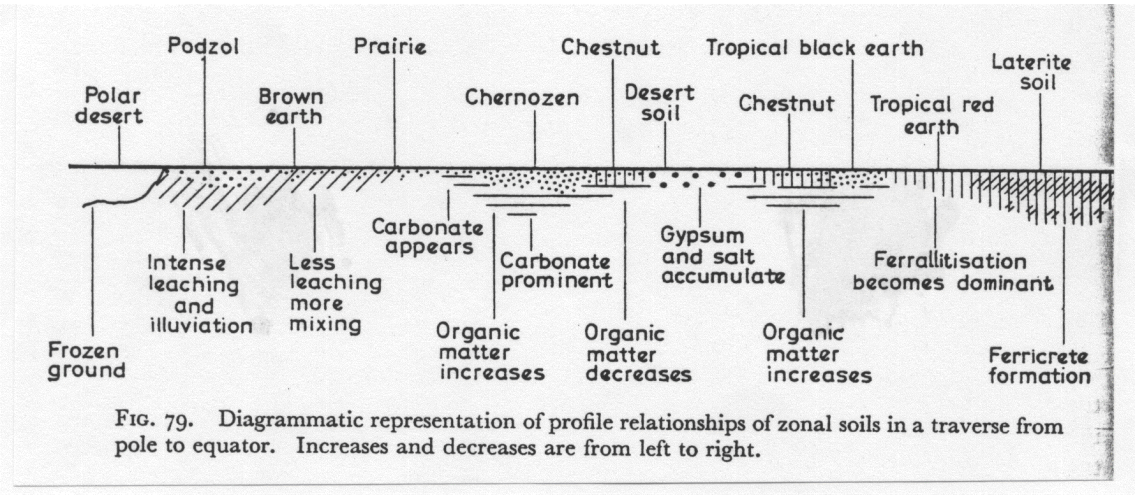

FIG. 79. Diagrammatic representation of profile relationships of zonal soils in a traverse from pole to equator. Increases and decreases are from left to right.

Ollier, C.D. 1975. *Weathering.* London: Longman. p. 148.

Table 2-1

The Ten Soil Orders of the "Seventh Approximation" *

Name of Order	Derivation of Order Name	Character of the Soils
Entisol	Nonsense syllable "ent," from "recent"	Negligible differentiation of horizons in alluvium, frozen ground, desert sand, etc., in all climates.
Vertisol	L. *verto,* turn, invert	Clay-rich soils that hydrate and swell when wet, and crack on drying. Mostly in subhumid to and regions.
Inceptisol	L. *inceptum,* beginning	Soils with only slight horizon development. Tundra soils, soils on new volcanic deposits, recently deglaciated areas, etc.
Aridisol	L. *aridus*, dry	Dry soils. Salt, gypsum, or carbonate accumulations common.
mollisol	L. *mollis*, soft	Temperate grassland soils with a soft, organic-enriched, thick, dark surface layer.
Spodosol	Gr. *spodos*, wood ash	Humid forest sods. Mostly under conifers, with a diagnostic iron- or organic-enriched B horizon and commonly also an ashy-gray leached A horizon.
Alfisol	syllables from the chemical symbols Al, Fe	Clay-enriched B horizon, young sods commonly under deciduous forests.
Ultisol	L. *ultimus,* last	Humid temperate to tropical soils on old land surfaces, deeply weathered, red and yellow, clay-enriched soils.
Oxisol	F. *oxide,* oxide	Tropical and subtropical lateritic and bauxitic soils. Old, intensely weathered, nearly horizonless soils.
Histosol	Gr. *histos*, tissue	Bog soils, organic soils, peat, and muck. No climatic distinctions.

*From the Soil Survey Staff of the U.S. Department of Agriculture, 1960.

Bloom, A.L. 1969. *The Surface of the Earth.* Englewood Cliffs: Prentice-Hall, Inc. p. 37.

Soil orders, approximate great soil groups, and weathering intensity

New order	Mnemonic	Approximate old great soil group	Dominant clay minerals
1. Entisols	Recent	Azonal soils, Humic-Gley soils	Montmorillonite, mica
2. Vertisols	Invert	Grumusols	Montmorillonite
3. Inceptisols	Inception	Ando, Sol Brun Acide, Brown Forest, Humic-Gley soils	Allophane, mica, interstratified layer silicates
4. Aridisols	Arid	Desert, Reddish Desert, Sierozem, Solonetz, Solonchak, Brown, and Reddish-Brown soils	Mica, vermiculite, interstratified layer silicates, chlorite
5. Mollisols	Mollify	Chestnut, Chernozem, Prairie, Rendzina, Brown, Brown Forest, Solonetz, Humic-Gley soils	Montmorilionite, mica, vermiculite, chlorite
6. Spodosols	Podzol	Podzols, Brown Poclzolic soils, Ground-Water Poclzols	Sesquioxides, interstratified layer silicates, 2:1/2:2 intergrades, mica
7. Alfisols	Pedalfer	Gray-Brown PocIzolic, Gray Wooded, Noncalcic Brown soils, Chernozem, Planosols, Half-Bog soils	Mica, montmorillonite, 2:1/2:2 intergrades, chlorite, kaolinite
8. Ultisols	Ultimate	Red-Yellow Poclzolic, Reddish-Brown Lateritic, Half-Bog soils, Planosols	Kaolinite, halloysite, vermiculite, 2:1/2:2 intergrades, sesquioxides, gibbsite
9. Oxisols	Oxide	Latosols, Laterite soils	Sesquioxides, gibbsite, kaolinite, 2:1/2:2 intergrades
10. Histosols	Histology	Bog soils	Variable

From Soil Survey Staff (1%0). Also from Jackson (1964), in Chemistry of the Soil, ed. F. E. Bear, by permission. 0f Van Nostrand Reinhold Co., New York.

Classification of the soils

(from USDA Hamilton County Soil Survey)

The system of soil classification used by the National Cooperative Soil Survey has six categories (16). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 19, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soilforming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Alfisol.

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name Of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs *(Hapl,* meaning minimal horizonation, plus *udalf,* the suborder of the Alfisols that have a Udic moisture regime).

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

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the Properties are those of horizons below plow depth where

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

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

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (13). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (16). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Ava series

The Ava series consists of deep, moderately well drained soils on side slopes on uplands. These soils formed in 30 to 45 inches of Peoria loess over an older loess that is underlain by a paleosol of Illinoian or earlier age. They have a fragipan. Permeability is moderately slow above the fragipan and very slow in the fragipan. Slope ranges from 0 to 15 percent.

In Hamilton County, the Ava soils are taxadjuncts to the Ava series because they have lower chroma mottles in the upper part of the subsoil than is defined in the range for the Ava series. This difference, however, does not significantly alter the use or behavior of the soils.

Ava soils are similar to Rossmoyne soils and are commonly adjacent to Parke and Switzerland soils. Parke and Switzerland soils do not have a fragipan. Parke soils are redder in the lower part of the solum. Rossmoyne soils formed in a thinner loess mantle. In Switzerland soils, the lower part of the subsoil formed in residuum of Ordovician Shale and Limestone.

Typical peclon of Ava silt loam, 0 to 3 percent slopes, about 1.5 miles northeast of Delhi, in Delhi Township, about 2,700 feet west and 2,700 feet north of the southeast corner of sec. 30, F. R. 1, T. 3.

Ap 0 to 9 inches; brown (1 OYR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many roots; many pores; very strongly acid; abrupt smooth boundary.

B1 9 to 15 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct yellowish brown (10YR 5/8) and common medium faint brown (10YR 5/3) mottles; weak fine and medium subangular blocky structure; friable; many roots; many medium pores; dark brown (1 OYR 4/3) organic stains on faces of peds and lining pores and root channels; very strongly acid; clear smooth boundary,

B21t 15 to 23 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct yellowish brown (1 OYR 5/8) and many medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; common fine roots; many fine pores; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; few pale brown (1 OYR 6/3) silt coatings on faces of peds; very strongly acid; clear smooth boundary.

B22t 23 to 33 inches; yellowish brown (10YR 5/4) silt loam; many coarse distinct yellowish brown (10YR 5/8) and grayish brown (1 OYR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; many fine pores; thin continuous grayish brown (10YR 5/2) clay films on faces of pods; thin discontinuous light brownish gray (10YR 6/2) coatings of A2 material on faces of peds; very strongly acid; clear wavy boundary.

Bx1 33 to 46 inches; yellowish brown (10YR 5/6) silt loam; moderate very coarse prismatic structure parting to moderate medium and coarse angular blocky; firm and brittle; few fine flattened roots between prisms; many fine vesicular pores; thick continuous grayish brown (10YR 5/2) clay films on faces of peds and lining pores; thin continuous light brownish gray (10YR 6/2) silt coatings on faces of prisms; thick gray (10YR 5/1) clay seams; very strongly acid; diffuse irregular boundary.

IlBx2 46 to 57 inches; yellowish brown (10YR 5/4) silt loam; moderate very coarse prismatic structure parting to moderate coarse angular blocky; very firm and brittle; thick continuous grayish brown (10YR 5/2) clay films on faces of peds and lining pores; thin continuous light brownish gray (10YR 6/2) silt coatings on faces of prisms; thick gray (10YR 5/1) clay seams; many very dark brown and black small concretions (iron and manganese oxides) on faces of peds; very strongly acid; diffuse irregular boundary.

IlBx3 57 to 66 inches; yellowish brown (10YR 5/4) silt loam; moderate very coarse prismatic structure parting to moderate coarse angular blocky; firm and brittle; thick continuous grayish brown (10YR 5/2) clay films on faces of peds and lining pores; thin continuous light brownish gray (10YR 6/2) silt coatings on faces of prisms; thick gray (10YR 5/1) clay seams; common very dark brown and black stains and small concretions (iron and manganese oxides); strongly acid; clear smooth boundary.

IIB31t 66 to 76 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium and coarse subangular blocky structure; firm; light gray (10YR 6/1) and strong brown (7.5YR 5/8) vertical seams and pockets; thin patchy dark yellowish brown (1 OYR 4/4) clay films on faces of peds; common black stains (iron and manganese oxides) on faces of peds; strongly acid; diffuse wavy boundary.

IIIB32t 76 to 86 inches; brown (7.5YR 5/4) and strong brown (7.5YR 5/6) silty clay; weak coarse subangular blocky structure; firm; brown (7.5YR 5/2) vertical seams; thin patchy gray (10YR 5/1) clay films on faces of peds; few black stains (iron and manganese oxides) on faces of peds; medium acid; clear wavy boundary.

LllCl 86 to 96 inches; dark yellowish brown (10YR 4/4) clay; weak coarse subangular blocky structure; firm; gray (1 OYR 5/1 and 6/ 1) vertical seams; few black stains (iron and manganese oxides) on faces of peds; medium acid; diffuse irregular boundary.

IIIC2 96 to 118 inches; strong brown (7.5YR 5/6) clay; common medium faint yellowish brown (10YR 5/8) and common medium distinct light gray (10YR 6/1) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; common stains (iron and manganese oxides) on faces of peds; neutral; gradual irregular boundary.

IIIC3 118 to 131 inches; light brownish gray (2.5Y 6/2) silty clay; many coarse distinct strong brown (7.5YR 5/8) and light gray (10YR 6/1) mottles; massive; firm; common black or very dark brown (10YR 212) stains (iron and manganese oxides) on faces of peds; hard rock at 131 inches; neutral at 118 to 125 inches, mildly alkaline at 126 to 131 inches.

Solum thickness ranges from 60 to 90 inches. Depth to the fragipan ranges from 25 to 40 inches. Thickness of the fragipan ranges from 24 to 50 inches. The thickness of the Peoria loess ranges from 30 to 45 inches. Depth to the paleosol ranges from 60 to 90 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4.

The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam.

The Bx horizon has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam.

The B3t horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silty clay or silty clay loam.

The C horizon has hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 8. It is silt loam to clay.

Avonburg series

The Avonburg series consists of deep, somewhat poorly drained soils on till plains. These soils formed in loess and the underlying Illinoian glacial till. These soils have a fragipan. Permeability is moderate above the fragipan and very slow in and below the fragipan. Slope is 0 to 2 percent.

Avonburg soils commonly are adjacent to Rossmoyne soils and are similar to Fincastle soils. Fincastle soils formed in Wisconsinan glacial till and loess and do not have a fragipan. Rossmoyne soils do not have **dominant low** chroma in the matrix or on faces of peds in the argillic horizon.

Typical pedon of Avonburg silt loam, 0 to 2 percent slopes, in the city of Blue Ash, in Sycamore Township, about 300 feet east and 1,500 feet south of the center of sec. 17, R. 1, T. 4.

Ap 0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 5/2) dry; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A2 9 to 14 inches; brown (1 OYR 5/3) silt loam; common medium distinct light brownish gray (10YR 6/ 2) mottles; weak medium platy structure; friable; common roots; few fine very dark brown (10YR 2/2) Concretions (iron and manganese oxides); slightly acid; clear smooth boundary.

B2tg 14 to 25 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak medium subangular blocky structure; friable; thin patchy light brownish gray (10YR 6/2) clay films and silt coatings on faces of peds and in pores; common fine very dark brown (10YR 2/2) concretions (iron and manganese oxides); strongly acid; clear irregular boundary.

Bx1g 25 to 40 inches; grayish brown (10YR 5/2) silty clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate very coarse prismatic structure; firm; thin to thick light gray (10YR 6/1) silt coatings on tops and vertical faces of prisms; many light gray (10YR 7/1) silt fillings in old root and crayfish channels; thin discontinuous gray (10YR 6/1) clay films on faces of peds and lining pores; prisms are separated by light gray (10YR 7/1) silt coatings; common very dark brown (10YR 2/2) concretions (iron and manganese oxides); compact and brittle; strongly acid; gradual wavy boundary.

IIBx2g 40 to 53 inches; grayish brown (10YR 5/2) clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; moderate very coarse prismatic structure parting to weak thick and very thick platy; firm; prisms are separated by light gray (10YR 7/1) thin silt coatings; thin continuous gray (10YR 6/1) clay films on faces of peds and lining pores; common very dark brown (10YR 2/2) concretions (iron and manganese oxides); few small angular chert fragments; compact and brittle; strongly acid; gradual wavy boundary.

IIB3 53 to 75 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct gray (10YR 5/1) mottles; weak coarse prismatic structure; firm; thin patchy gray (10YR 6/1) clay films on faces of peds and lining pores; few small angular chert fragments; few very dark brown (10YR 2/2) concretions (iron and manganese oxides); medium acid; gradual wavy boundary.

IIC 75 to 85 inches; yellowish brown (10YR 5/4) clay loam; many coarse distinct gray (10YR 5/1) mottles; massive; firm; common angular glacial till fragments; few concretions (iron and manganese oxides); slightly acid in the upper part grading to mildly alkaline, slight effervescence in the lower part.

Thickness of the solum ranges from about 60 to 90 inches. Thickness of the loess mantle ranges from 20 to 48 inches. Depth to the fragipan ranges from about 22 to 36 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2.

The A2 horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4.

The B2 horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 6. It is silt loam or silty clay loam. Reaction is strongly acid or very strongly acid.

The Bx horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 6. It is strongly acid or very strongly acid.

The B3 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It commonly is clay loam but is clay where the till has a large component from Ordovician Limestone and calcareous clay shale.