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SUBSURFACE STRATIGRAPHY OF THE PLEISTOCENE DEPOSITS OF CENTRAL NORTHERN ILLINOIS

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ABSTRACT

The subsurface Pleistocene drift sequence in central northern Illinois (Boone, DeKalb, and parts of Kane, LaSalle, Lee, McHenry, Ogle, and Winnebago Counties) is separated into several major units. These units are differentiated on the bases of lithologic character, stratigraphic position, and physical properties, including X-ray and grain-size data.

The following are the major units recognized. Unit A is a basal, predominantly quartz sand that is probably pre-Illinoian in age. Unit B, overlying Unit A, contains a brown, montmorillonitic, kaolinitic, sand-silt-clay to silty sand till of probable Illinoian age. Unit C (Winnebago drift), the surface drift of the northwestern part of the area, consists of illite-chlorite, silty sand, and sandy silt tills that can be subdivided into three Sub-units C-1, C-2, C-3, which are separated by local peat beds and organic silt. A C^{14} date of >38,000 years B.P. (W-1144) was determined from the base of a peat bed above Sub-unit C-2, while the upper till of Sub-unit C-3 may be as young as 31,000 years B.P. All of Unit C is included in the Altonian Substage of the Wisconsinan Stage. The remaining drifts (Units D, E, and F) are illite-chlorite tills predominantly sand-silt-clay and are assigned to the Woodfordian Substage of the Wisconsinan Stage.

INTRODUCTION

During Pleistocene glaciation, northern Illinois was covered by ice moving westerly from the Lake Michigan basin and by a subsidary lobe moving southwesterly from Green Bay. The glacial deposits form the surficial materials in this part of the state and contain important resources of ground water and supplies of sand and gravel. The age and classification of the deposits made by these glaciers has long been a subject for discussion. The deposits have been assigned various ages from Kansan to Wisconsinan (Chamberlin and Salisbury, 1885; Leverett, 1898, 1899; Alden, 1909, 1918; Bretz, 1923; Leighton, 1923; Ekblaw, 1929; Shaffer, 1954, 1956; Leighton, 1958, 1960; Leighton and Brophy, 1961, 1963; Frye and Willman, 1960; Frye, Glass, and Willman, 1962; Willman, Glass and Frye, 1963).

Previous interpretations have been based primarily on topographic and drainage relations, degree of dissection, depth of carbonate leaching and oxidation, and the presence of identifiable loess units, utilizing available outcrops and auger borings. Some recent interpretations have been based on lithologic and stratigraphic descriptions of the drifts of the area (Shaffer, 1956; Doyle, 1958) and on radiocarbon dates (Leighton, 1960; Frye and Willman, 1960). Investigations of the subsurface glacial stratigraphy for parts of this area have been reported by Horberg (1953) and Hackett (1960). The present restudy of the area is based on core samples from test borings along the Illinois Northwest Toll Highway and on carefully collected samples obtained from water well contractors. The detailed subsurface methods employed in this report, using specific physical property data, have been summarized by Kempton and Hackett (1962).

Knowledge of the subsurface glacial stratigraphy is needed for accurate delineation of the glacial drift aquifers and evaluation of their water-yielding potential. In addition, such knowledge can lead to a better understanding of the water transmitting properties of the nonaquifer drift units, engineering characteristics of the drift, mineral resources available, and the character and distribution of the parent material of soils. The Illinois State Geological Survey is investigating the subsurface stratigraphy, lighologic character, and physical properties of the glacial deposits as a part of a state-wide evaluation of the ground-water resources of the drift.

The area of the present study is in the eastern part of central northern Illinois and includes Boone and DeKalb Counties and portions of Kane, LaSalle, Lee, McHenry, Ogle, and Winnebago Counties (fig. 1). The area contains Troy Valley, one of the larger bedrock valleys of Illinois, and portions of its drainage basin (McGinnis et al., 1963). This report describes the basic glacial stratigraphy. The ground-water geology of the area and additional stratigraphic data will be presented in a subsequent report.

Acknowledgments

The excellent cooperation of several water well contractors who provided well logs and samples of drill cuttings is gratefully acknowledged. The X-ray analyses were made by H. D. Glass of the Illinois Geological Survey, who made helpful suggestions in interpretation of the clay mineralogy of the drift. I am indebted also to Professor Paul R. Shaffer, Department of Geology, University of Illinois and John C. Frye, James E. Hackett, H. B. Willman, and George E. Ekblaw of the Illinois Geological Survey for numerous discussions and critical reviews of the manuscript. This report is adapted from a doctoral dissertation submitted to the University of Illinois, based on research conducted at the Illinois Geological Survey. Professor George W. White, thesis advisor, provided many helpful suggestions and encouragement during the course of the study. All radiocarbon dates used in this report were determined in the Washington Laboratories of the U. S. Geological Survey.

STRATIGRAPHY

The Pleistocene fill of the Troy Valley averages more than 350 feet thick and is locally in excess of 550 feet thick. The deposits are largely Wisconsinan, but Illinoian and older deposits are present within the fill in DeKalb County (fig. 2).

The till and outwash that cover much of northern Illinois, which previously were called Illinoian (Horberg, 1953) and later Farmdale (Shaffer, 1954, 1956), have been named Winnebago (fig. 3) and have been assigned to the Altonian Substage of the Wisconsinan Stage (Frye and Willman, 1960). The remaining Wisconsinan drift of the area has been assigned to the Woodfordian Substage.

Informal letter designations have been assigned to rock stratigraphic units that are recognized in the present study. The locations of wells and borings used in this study are shown in figure 4 and table 1. Grain size and mineral analyses of typical samples are given in tables 2 and 3. Descriptions of samples from selected reference wells and borings are given in table 4.

Pre-Illinoian (?) Stage

Unit A.—Unit A is defined as the lowermost deposit encountered in the Troy Valley and is a basal sand or sand and gravel. A typical development of this unit is recorded from samples taken at 5-foot intervals from 405 to 445 feet in well 63 (fig. 4):

	Thickness (ft)	Base (ft)
Pleistocene Series		
Pre-Illinoian Stage		
Unit A		
Sand, clean, medium to coarse, little fine, subrounded to rounded, white, mostly quartz; some dolomite, chert, and few igneous grains	15	420
Gravel, slightly sandy, about 50% chert (some oolitic), 40% quartz, 10% igneous	10	430
Sand, slightly gravelly, chert (20%), mostly quartz, little dolomite, few igneous	15	445

Unit A may attain a maximum thickness of more than 140 feet where present in the deepest parts of the Troy Valley. The maximum thickness reported, in well 62 (fig. 4), is 78 feet, but this well encountered bedrock at least 70 feet higher than the bottom of Troy Valley. Unit A has not been found north of T. 40 N., in central DeKalb County, and is probably limited in extent to the southern part of the valley (figs. 5, 6, 7).

The sand consists principally of quartz grains that are usually subrounded to rounded and occasionally polished. Aside from the quartz, the grains are composed of light and dark igneous rocks, dolomite, and chert. A gravel bed within this unit (see above sample study) contains an abundance of oolitic chert. The average grain count of Unit A from wells 61, 62, 63, and 70 is as follows:

quartz, some feldspar	74%
chert	12%
dolomite	10%
igneous	4%

The sand is generally white or has a pale pink tinge. Locally, the presence of weathered dolomite and chert grains at the base gives a light buff to light yellowish-brown appearance to the sand. Unit A is generally medium grained but ranges from very fine silty sand to coarse gravelly sand. A maximum of about 20 feet of weathered-appearing very silty to clayey sand is present at the top in well 62. It is quite possible that some lacustrine sediments also may be included in the upper portion of the unit, giving a weathered appearance.

Horberg (1950, p. 51-52) named the basal sand of the bedrock valleys in the Peoria region the Sankoty Sand for its development in the Sankoty "water" field north of Peoria. Horberg (1953) later extended this unit throughout the remainder of the area covered by Wisconsinan drift, including the Paw Paw and Rock Valleys. He traced the Sankoty as far north as Mendota in LaSalle County or about three miles east of the southwestern part of this study area (figs. 1, 4). Horberg (1953, p. 20) states that the basal sand at Mendota is without distinctive properties and his correlation is based on elevation and stratigraphic position. Unit A is similar in general appearance, quartz-grain percentage, position, and elevation to the Sankoty Sand (Horberg, 1953, fig. 3, p. 15). The major difference is the presence of large proportions of chert and dolomite in the sand in Troy Valley.

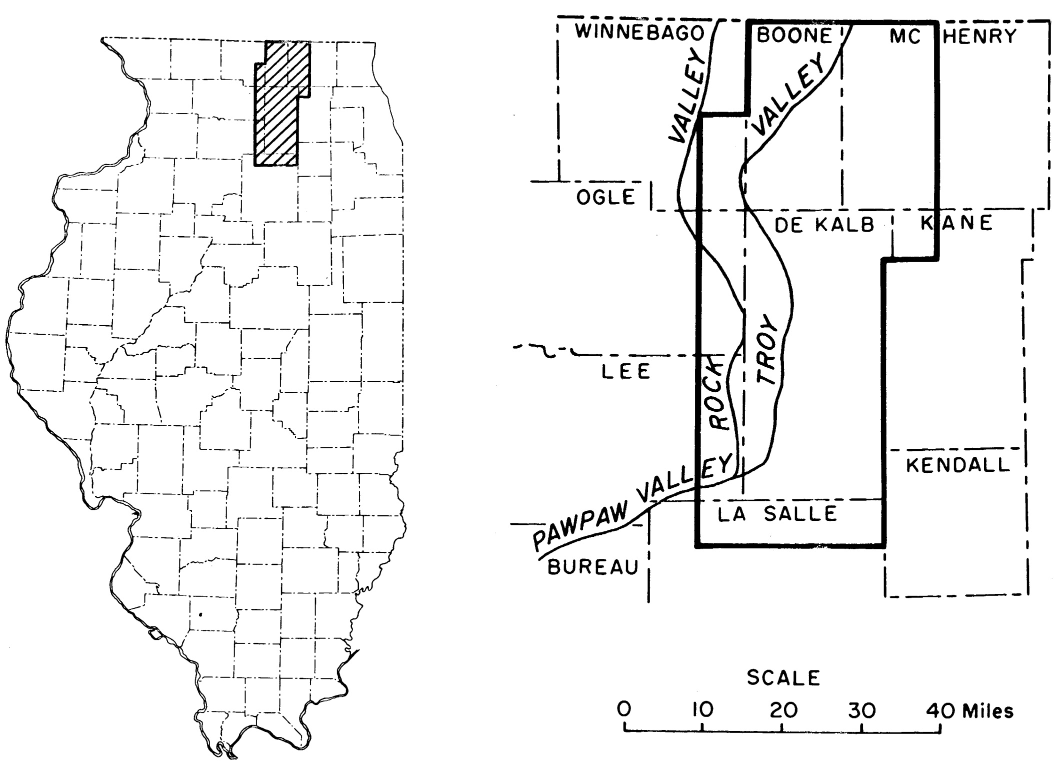


Fig. 1 - Location of area and major bedrock valleys.

Stage(s)	Substage	Unit and Sub-unit		Thickness (ft)		Composition
Wisconsinan	Woodfordian	F			0–60	Till, variable texture; outwash; lake deposits
		E			0–150	Till, sand-silt-clay; outwash
		D	D-3	0–15	0–100	Till, sand-silt-clay; outwash; lake and wind deposits
			D-2	0–25		
			D-1	0–30		
	Farmdalian	Interstadial			0–18	Silt, organic silt, sand
	Altonian	C	C-3	0–150	0–400	Till, silty sand; outwash; lake, colluvial, and wind deposits
		Winnebago	Inter-stadial	0–10		Peat, organic silt, silt, clay
			C-2	0–175		Till, silty sand; outwash; lake, colluvial, and wind deposits
			C-1	0–35		Till, sandy silt, sand-silt-clay; outwash and lake deposits
Sangamonian						[Weathering, erosion]
Illinoian(?)		B			0–200	Till, silty sand; outwash and lake deposits
Pre-Illinoian(?)		A			0–140	Sand; some gravel; lake deposits

Fig. 2 - Classification of glacial deposits.

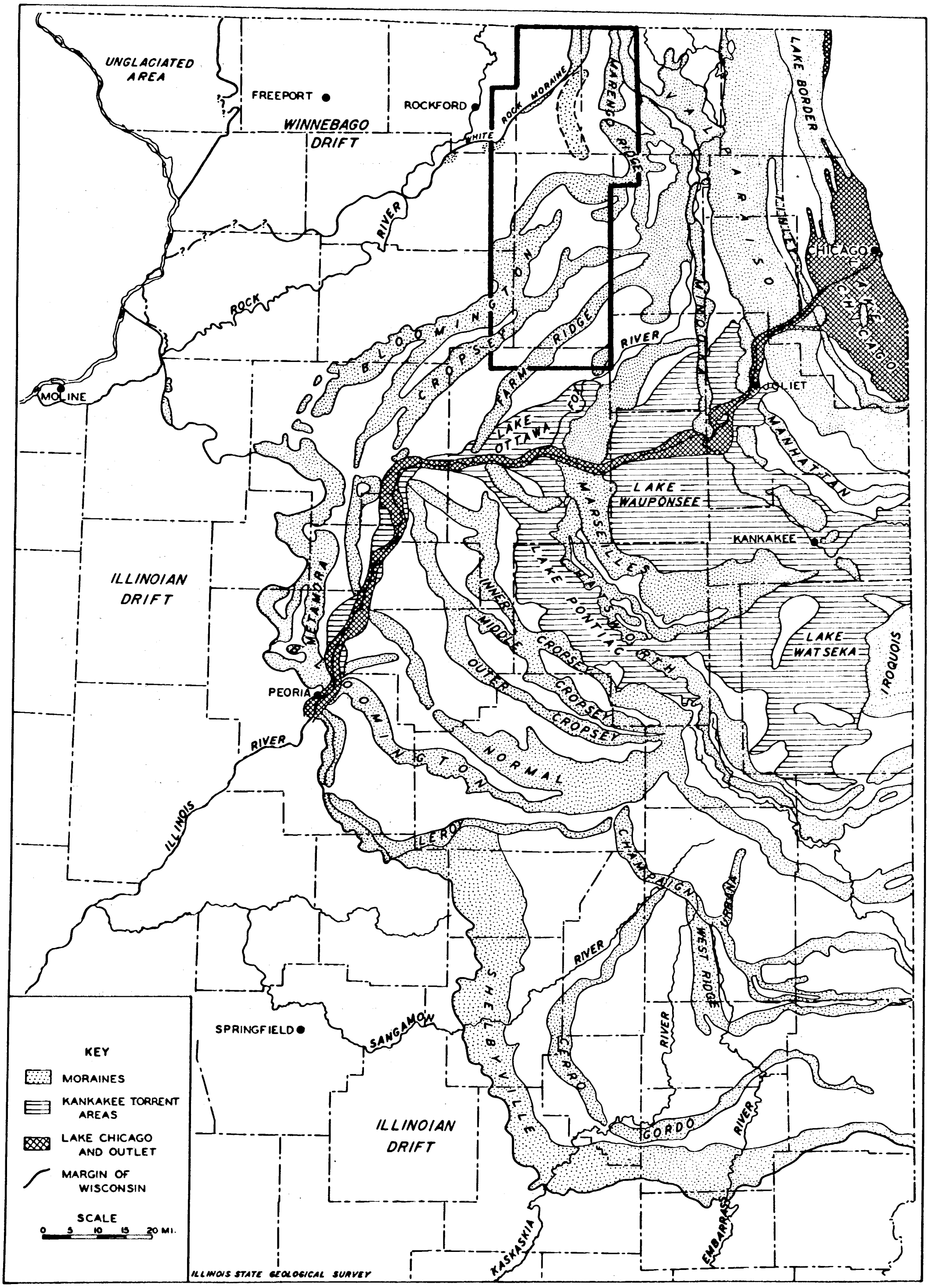


Fig. 3 - Glacial map of northeastern Illinois (modified from Ekblaw, 1960).

Horberg (1953, p. 14) suggested that the Sankoty Sand is present under Kansan drift and under drift possibly of Nebraskan age in central Illinois. In the Troy Valley, Unit A is directly overlain by deposits of probable Illinoian age. No evidence of leaching of carbonates was found at the top of Unit A in the samples studied. The age of the unit in the Troy Valley and elsewhere is in doubt, and it is assigned to a pre-Illinoian (?) age until more definite relations can be established.

There is no indication of the position of the ice front during deposition of Unit A. Although the sand has not been found in the Troy Valley in Boone County, Hackett (1960) suggests that the thin basal sand in the Ancient Rock Valley in Winnebago County may be equivalent in age to the Sankoty. If this interpretation is correct, the glacier probably reached the upper portions of the Troy and Ancient Rock drainage basins, and much of the outwash deposited in the upper portions of these valleys was subsequently eroded. The silty character of the upper part of Unit A may indicate ponding of the Troy Valley during latter stages of outwash deposition.

Illinoian (?) Stage

Unit B.—Unit B is defined as the sequence of deposits that either overlies Unit A or directly overlies the bedrock in the Troy Valley and adjacent areas (figs. 6, 7). It consists of till, outwash sand and gravel, and lacustrine sediments. A distinctive clay mineral suite and grain-size distribution aid in separating the till from the tills of Unit C. An excellent section was encountered in well 68 at a depth of 155 to 210 feet (table 4, fig. 8).

In the lower part of the Troy Valley, Unit B can be identified from T. 38 N., R. 3 E. to T. 40 N., R. 3 E., DeKalb County, but it appears to be absent on the uplands adjacent to the valley. It is present in a valley tributary to the Troy in T. 41 N., R. 4 E., DeKalb County (well 68).

In general, the till of this unit is sand-silt-clay (fig. 14) although it borders the silty sand range (size ranges used—sand, 2.0 to 0.062 mm; silt, 0.062 to 0.0039 mm; clay <0.0039 mm). The till is variable in color, but most often is dark brown, brown, or grayish brown (10YR 4/3 to 10YR 4/2; all Muncell colors used in this report are taken from wet samples). The upper part of Unit C, as much as 20 feet, is commonly greenish or yellowish brown (2.5YR 4/4-3/2 or 10YR 4/4).

The bulk of the outwash included in this unit occurs in the vicinity of the northernmost extent of the till (fig. 6). Here the upper 20 feet is a typical glacial outwash with about 20 percent of the grains of igneous or metamorphic origin. Below 20 feet the outwash becomes more typical of Unit A and may actually belong to that unit. Although there is ordinarily no indication of weathering at the top of the outwash, one driller's log (well 55) reports a green clay at this position.

The lacustrine sediments in Unit B, consist of dark brown (10YR 3/2 to 10YR 2/2), faintly laminated, clayey silt with abundant small woody fragments on the bedding planes (well 70, 375-395 feet, table 4). Some appear more like bedded tills and are greenish brown (2.5YR 3/2 to 10YR 4/4) in color (well 68, 175-190 feet, table 4).

The relatively high percentage of montmorillonite and the presence of kaolinite (well 62, 340-360 feet, well 68, 155-210 feet, tables 2, 3, fig. 8), distinguish Unit B from Unit C. The relatively small amount of both calcite

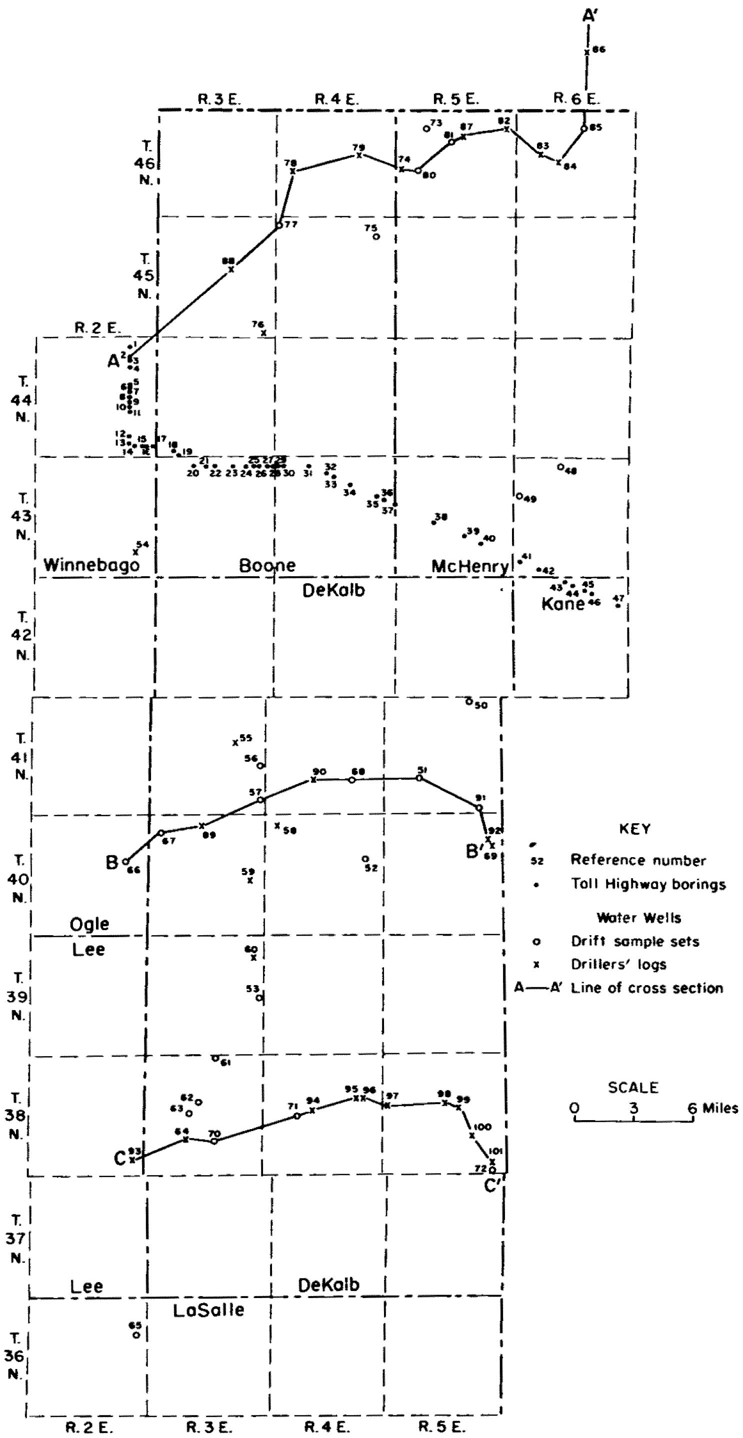


Fig. 4 - Index map of wells and cross sections.

and dolomite present and the erratic distribution of these minerals in the fine fractions of the sediments are characteristic of the lower part of the unit (fig. 8).

The assignment of Unit B to the Illinoian Stage is based primarily on stratigraphic position and clay mineralogy. The clay mineralogy is generally the same as the Payson drift, which was deposited by the earliest and most widespread of the Illinoian advances (Willman, Glass, and Frye, 1963, p. 17-22 and fig. 7, p. 21).

The absence of a leached zone on Unit B leaves the possibility open that Unit B may be part of the Winnebago drift (Unit C) and Altonian in age. However, few well samples are available, and active erosion within the valley area could have removed evidence of leaching. Also, the suggestion of a truncated weathering profile on Unit B in well 68 (table 2, 4, fig. 8), as evidenced by the progressively greater alteration of chlorite upward, supports a pre-Wisconsinan age for Unit B. The dark brown clayey silt at the base (well 70, 375-395 feet, tables 2, 4) may be pro-Illinoian and equivalent to the Petersburg Silt of western Illinois (Willman, Glass, and Frye, 1963, p. 6).

Although the predominant direction of movement of the Illinoian glacier in this region was westward from the Michigan Basin, a tongue moved northward into the Troy Valley, spread over onto the immediately adjacent upland at some

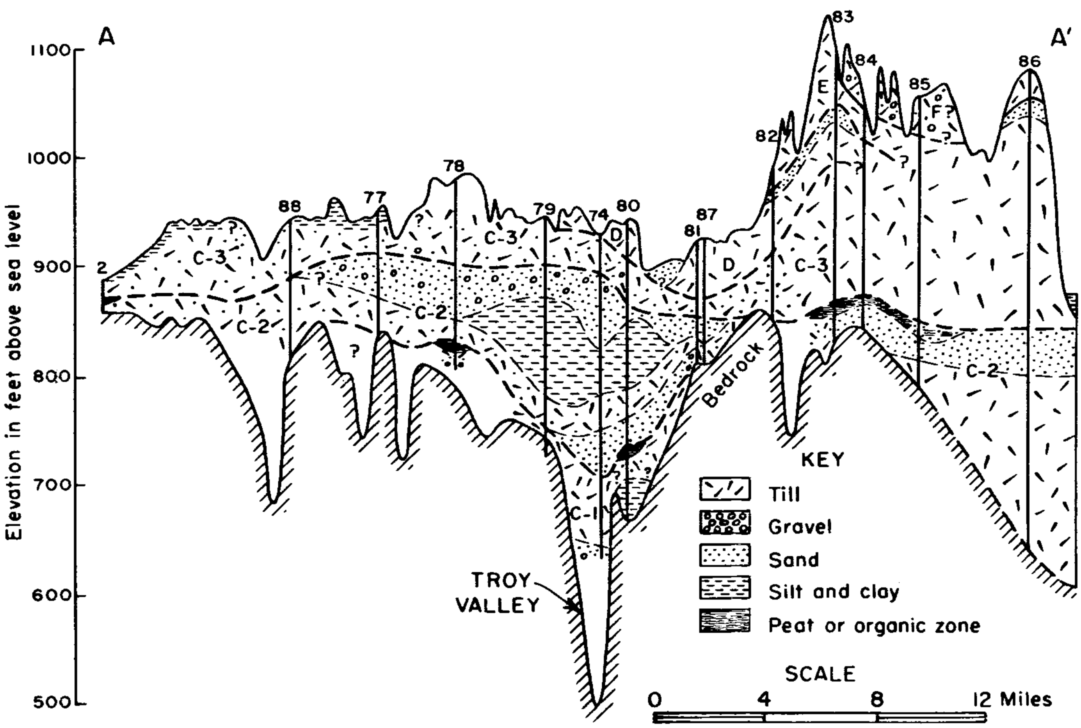


Fig. 5 - Cross section A-A' (North).

places, and flowed into the tributary valleys. The presence of kaolinite in the deposits also indicates that the ice moved over the kaolinitic Pennsylvanian rocks to the south before moving into the Troy Valley. When the ice occupied the valley, drainage was ponded in the upper part of the valley forming an extensive lake. During oscillations of the ice front, deposits in the lake were overridden by readvances of the ice. The outwash fan, extending northward in front of the advancing ice, was also partially overridden. With the retreat of Illinoian ice, drainage again returned to a southward direction, and it continued southward during the Sangamonian Stage.

Wisconsinan Stage

Altonian Substage

<u>Unit C (Winnebago drift)</u>.—Unit C is the complex sequence of deposits of the Winnebago drift (Shaffer, 1956; Hackett, 1960, Frye and Willman, 1960). It overlies Unit B or the bedrock in the Troy Valley area, and it is exposed at the surface in much of northern Boone and Winnebago Counties. Within this unit at

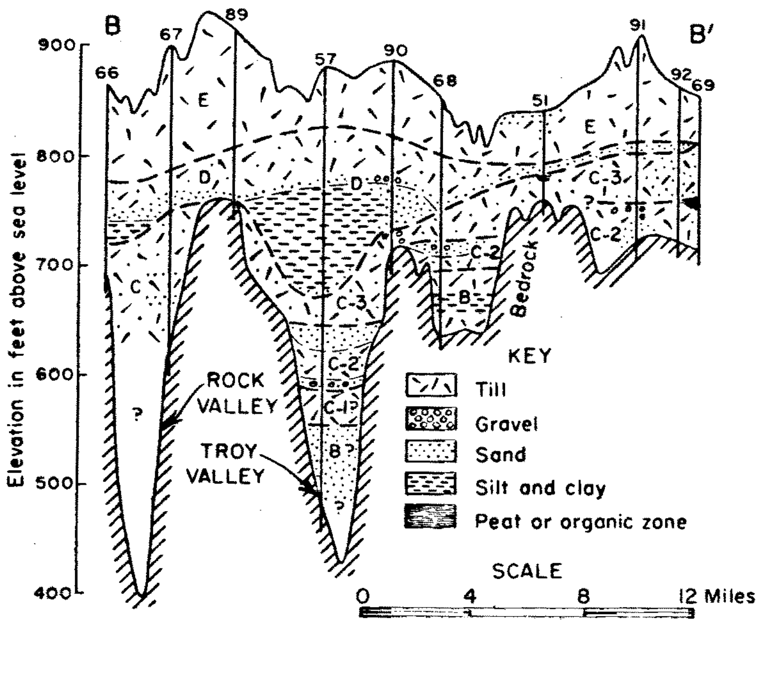


Fig. 6 - Cross section B-B' (Central).

least three tills can be recognized locally. Along with related outwash and lacustrine sediments, these tills are designated C-1, C-2, C-3 from the base to the top of the unit (fig. 2). Samples from test drilling along the Northwest Toll Highway (fig. 4, table 1) have aided materially in defining the sub-units. Their identification from water well samples is more difficult. The character of the sub-units is shown in boring 11 (fig. 10, tables 2, 4).

One or more sub-units of Unit C are present throughout nearly all of the Troy Valley area and adjacent uplands. Unit C attains a maximum thickness of about 400 feet in Tps. 44 and 45 N., Rs. 3 and 4 E., Boone County, where it includes most of the drift recognized in the northwestern part of the area (figs. 3, 5). Thus Unit C is the most extensive and often the thickest drift of the study area.

Unit C consists of till, outwash sand and gravel, and minor amounts of lacustrine sediments. In general, the tills are silty sand (figs. 14, 15) and are dark brown, dark reddish or violet gray, or dark gray in color. They are also very hard with a consistency or relative density (N value) generally above 100 as indicated by the standard penetration tests conducted during the test boring and sampling along the toll highway. The unaltered till of Unit C contains, on the average, 7 percent montmorrillonite, 68 percent illite, and 25 percent chlorite (table 3). Kaolinite has not been found to be present in the till samples analyzed.

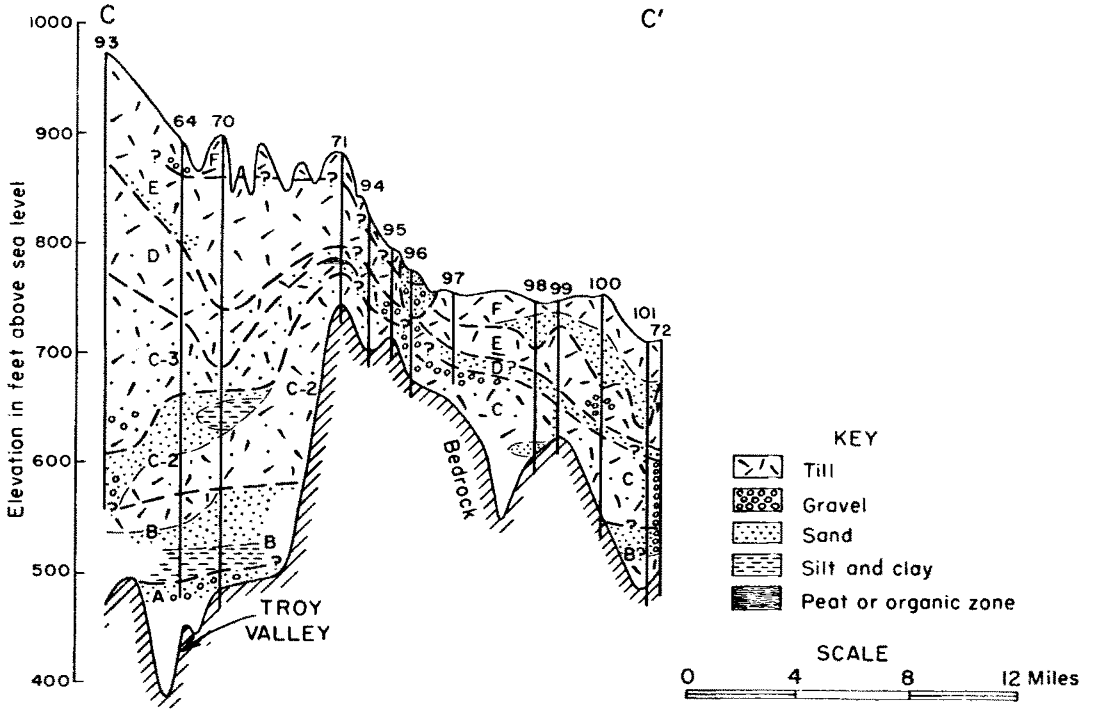


Fig. 7 - Cross section C-C' (South).

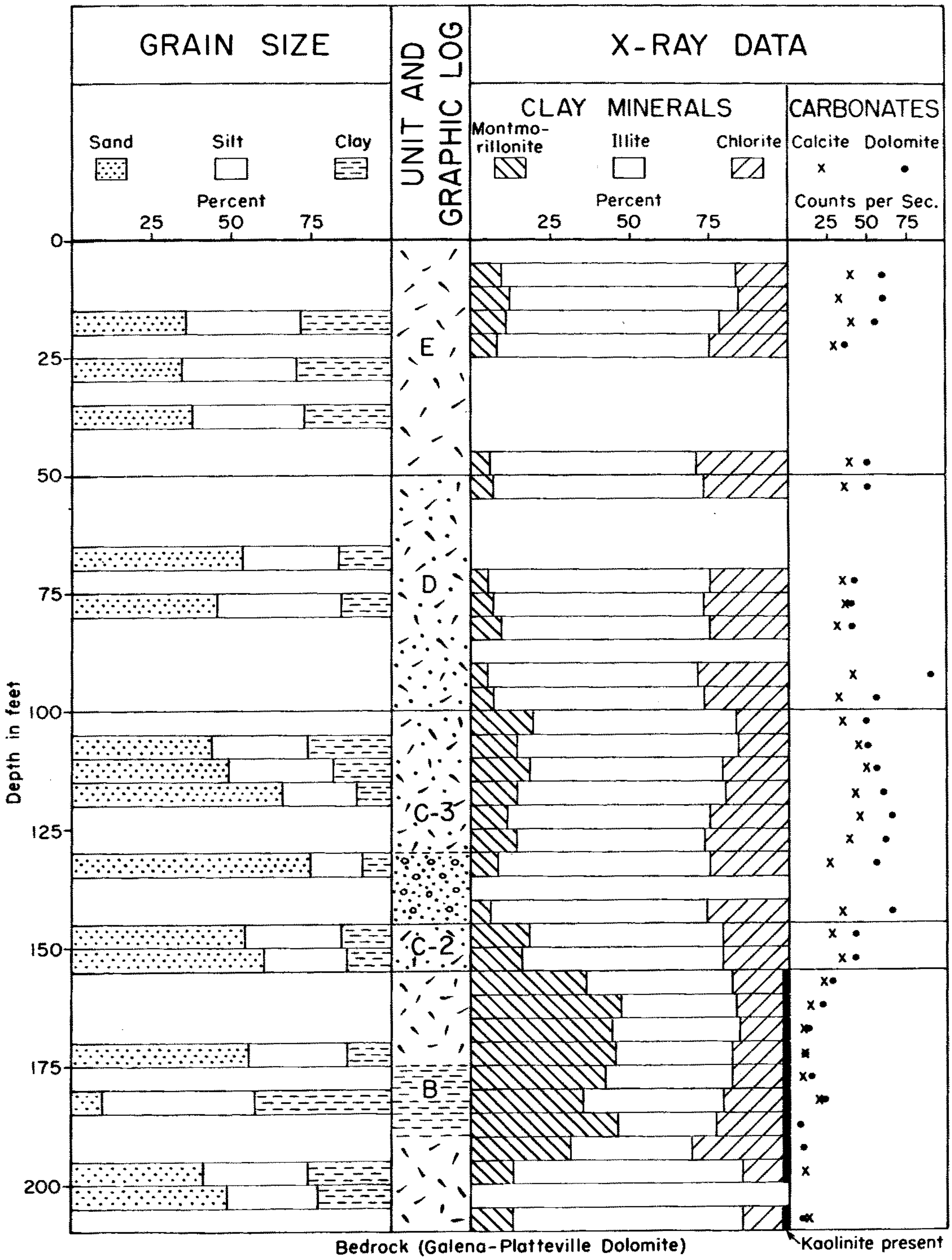


Fig. 8 - Percentage of sand, silt, and clay, and X-ray data for well 68.

Sub-unit C-1.—The till of Sub-unit C-1 is distinguished primarily by sand-silt-clay to sandy silt texture (fig. 15) and gray, dark grayish brown, or dark brown to reddish brown color (10YR 4/1, 10YR 4/2, 10YR 3/3). There is no leaching but indication locally of some weathering at the top of the unit, and a thin organic zone rests on C-1 at two localities (fig. 5, wells 78, 80). The till of Sub-unit C-1 has an average clay mineral composition of 6 percent montmorillonite, 71 percent illite, and 23 percent chlorite. It can be identified with assurance only along and generally north of the toll highway in Winnebago, Boone, and McHenry Counties (figs. 5, 9, 10, 11).

Sub-unit C-2.—This sub-unit is composed predominantly of till with some associated outwash. The till is brownish gray to gray (10YR 4/2, 10YR 4/1), silty sand (fig. 15), and frequently contains fragments of tough, brownish black shale with tasmanites. The average clay-mineral composition of the till is 7 percent montmorillonite, 67 percent illite, and 26 percent chlorite (table 3). A locally thick sand and gravel, with some interbedded silt and clay, is present at the top of the sub-unit over large areas (fig. 5).

A leached organic silt and peat (boring 2, figs. 5, 11, table 4) overlies an oxidized zone at the top of this unit and substantiates the presence of at least two sub-units of Unit C in the area where the Winnebago drift is the surface drift. The organic-rich deposits consist of black, leached, slightly sandy silt with a few pebbles (some dolomite) and abundant fine particles of organic material. The peat sampled in boring 41 is a loose accumulation of woody materials and plant tissue with some twigs, 2 to 3 inches long. Some silt and sand is present in the

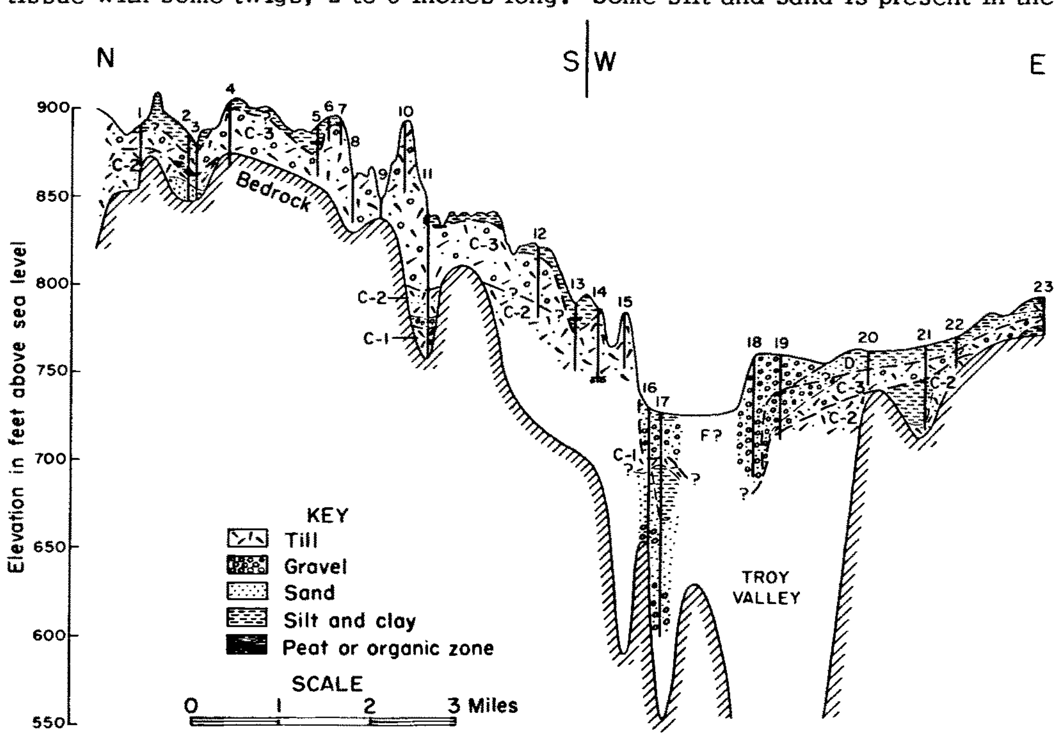


Fig. 9 - Northwest Toll Highway cross section 1 (West).

middle of the peat zone. A radiocarbon data of >38,000 years B.P. (W-1144) was obtained from the base of the peat in boring 41 (35-$36\frac{1}{2}$ feet). Below these deposits, the till or sand of C-2 are generally dark yellowish brown (10YR 4/4) to greenish brown (2.5YR 4/4) in color for a few feet. In boring 41 the leached material directly below the peat is probably an accretion-gley. Elsewhere no leaching of C-2 has been found where it is covered by younger deposits.

Sub-unit C-3.—The till of Sub-unit C-3 is composed principally of silty sand (fig. 15), often interbedded with lenses of sand and gravel. The till of this unit is generally violet-gray to brown (7.5YR 4/2 or 10YR 4/3) and occasionally grayish brown (10YR 4/2). The clay mineral content of the unaltered till averages 8 percent montmorillonite, 65 percent illite, and 27 percent chlorite.

Where Sub-unit C-3 forms the surface drift, the till is deeply oxidized to light yellowish to reddish brown (10YR 5/4 to 7.5YR 5/4). Shaffer (1956) describes the upper 7 to 10 feet of the till as being frequently light pink to salmon in color (7.5YR 8/4 dry). Where the loess capping is thin (boring 11, tables 2, 4), oxidation and alteration of the chlorite in the till may extend as deep as 25 to 35 feet. Where the loess is more than 5 feet thick weathering of the till is less than 15 feet (boring 5, tables 2, 4). The till is leached less than 3 feet under thick loess and as much as 6 or 7 feet under thin loess. Shaffer (1956, p. 16) reports that leaching and staining may be as much as $11\frac{1}{2}$ feet where stratified drift is very sandy. There is also subsurface evidence of leaching or alteration at the top of this unit, with local thin organic silt capping the Sub-unit C-3 and underlying Unit D (boring 40, well 51, figs. 6, 11, 13).

The regional extent, age, and correlation of the sub-units of Unit C are not known precisely at present although numerous lines of evidence are now available. In the Rock Valley at Rockford, Hackett (1960, p. 31-33, and fig. 7,

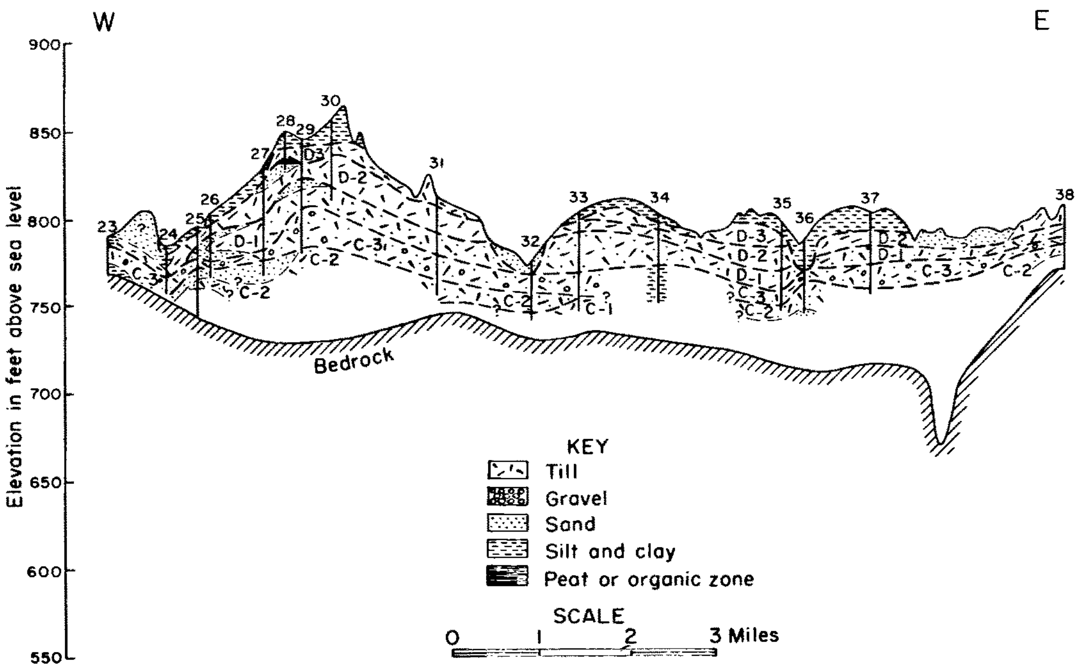


Fig. 10 - Northwest Toll Highway cross section 2 (Center).

p. 30) demonstrated the presence of two tills (then assigned to earlier and later Farmdale advances), which may be correlative to Sub-units C-2 and C-3. Willman, Glass, and Frye (1963, p. 7-8 and fig. 1) indicate that drift deposits at Danville (Ekblaw and Willman, 1957; W-256) and at Bloomington (Ekblaw, 1946; W-186) may be assigned to the Altonian Substage and may be contemporaneous with one or more sub-units of the Winnebago. Black (1958) describes the occurrence of wood dated at 31,800±1,200 radiocarbon years (W-638) taken from a pinkish till on the uplands south of Lake Geneva in extreme southern Wisconsin. Along with other dates in this range further north, Black (1959, 1962) has postulated an advance probably equivalent to that which deposited Sub-unit C-3.

From the evidence presented, it appears that Sub-unit C-1 records the earliest advance of Altonian ice and therefore of the Wisconsinan Stage. Deposits of this sub-unit are generally thin and scattered and often absent or not recognizable. There is evidence of a time lapse between the deposition of C-1 and C-2, mainly in the form of peat and some channeling.

One of the two major glacial advances of the Altonian began prior to 38,000 radiocarbon years ago and covered the entire area, as indicated by the widespread occurrence of Sub-unit C-2. This ice sheet advanced from the east or northeast from the Lake Michigan basin. As it advanced over the southern part of the Troy

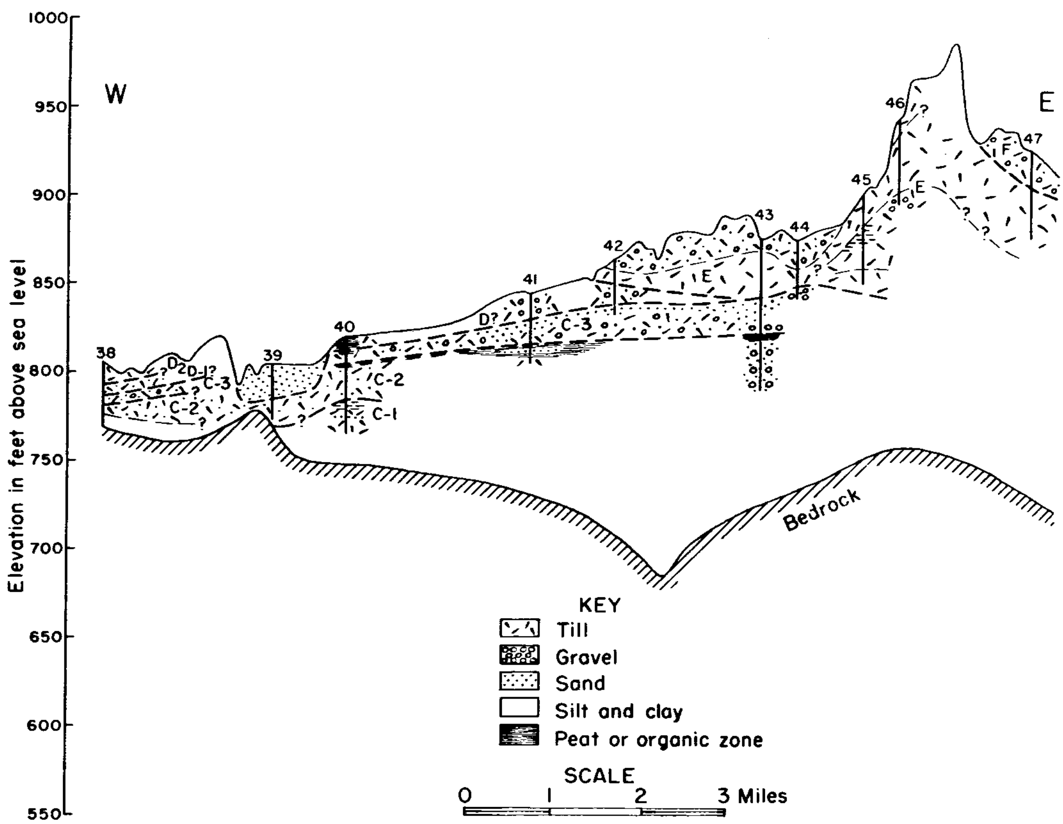


Fig. 11 - Northwest Toll Highway cross section 3 (East).

Valley, it produced moderate to large amounts of outwash, which filled channels cut into older deposits. Thick drift was deposited throughout most of the region and made a relatively flat till plain over the uplands, particularly in Boone and McHenry Counties (fig. 5). However, Troy Valley was not completely filled.

After the ice retreated, peat bogs, trees, and other vegetation developed over the area, and shallow depressions were filled with organic silts and clays. Soils developed on the higher areas, but the deposits generally were leached only to shallow depths. Drainage was reestablished along the Troy Valley and deep channels were cut into the till. The streams generally regained a southward flow. These developments marked an important interstadial within the Altonian, which began more than 38,000 years B.P.

The final Altonian advance came from the northeast, reached Lake Geneva 31,800±1200 radiocarbon years ago, and eventually covered most if not all of the area of this study. This advance appears to have been relatively short, as the Farmdale silt that overlies this unit is at least 26,1000±600 years B.P. (W-381) elsewhere in Illinois. The evidence in the Troy Valley area indicates that it did build moraines during retreat. Some were low, as under the ridge just southeast of Belvidere in southeastern Boone County (figs. 3, 10), but others were rather large and extensive, as under Marengo Ridge (figs. 3, 5) and also the till spur at Rockford (Hackett, 1960, p. 31 and fig. 7, p. 30). The drift surface was much more irregular than the preceding (C-2) outwash and till plain surface. Thus, end moraines and other irregularities of the surface, as expressed by these deposits, locally appear to form an ancestral topography to that visible today, where overlain by younger drift.

Woodfordian Substage

Unit D.—Unit D is the oldest of the Woodfordian drifts. It forms much of the surface drift in front of the Bloomington and Marengo end moraines up to and including the White Rock end moraine (figs. 3, 5). In the subsurface south of the front of the Bloomington end moraine, the unit is directly overlain by Unit E (figs. 6, 7). The tills of Unit D have not been identified over the bedrock uplands east of the Troy Valley in eastern DeKalb County, where only a thin sand occurs between Units C and E (fig. 6). Unit D attains a maximum thickness of about 150 feet over the Troy Valley in central DeKalb County.

The tills of this unit are generally pinkish gray, pinkish brown to brown in color (7.5YR 4/2, 7.5YR 5/4 to 10YR 4/3). The tills oxidize to dark yellowish brown, yellowish brown to light brown (10YR 4/4, 10YR 5/4 to 10YR 5/8). The tills of Unit D are less compact than the deposits of Unit C and have a N value less than 50 and commonly under 30 (fig. 12).

The tills can generally be classified as sand-silt-clay (fig. 17) and usually are distinct from those of Units C and E at a given locality (fig. 14). The grain size of the tills of Unit D is quite comparable to that of the "Shelbyville" to the west (Shaffer, 1956, p. 24 and fig. 3, p. 23). The textural distinction of Unit D from Unit E is somewhat narrow, although Unit E is slightly more silty (fig. 17). Where Unit D is the surface drift, the upper 3 to 5 feet is leached.

Unit D is divided into Sub-units D-1, D-2, and D-3. These sub-units are differentiated on minor and somewhat inconsistent textural variations (fig. 16) and are based on samples from borings 23-38 (fig. 4, tables 1, 2) along the Northwest Toll Highway. The sub-units are developed best in boring 29 (table 4).

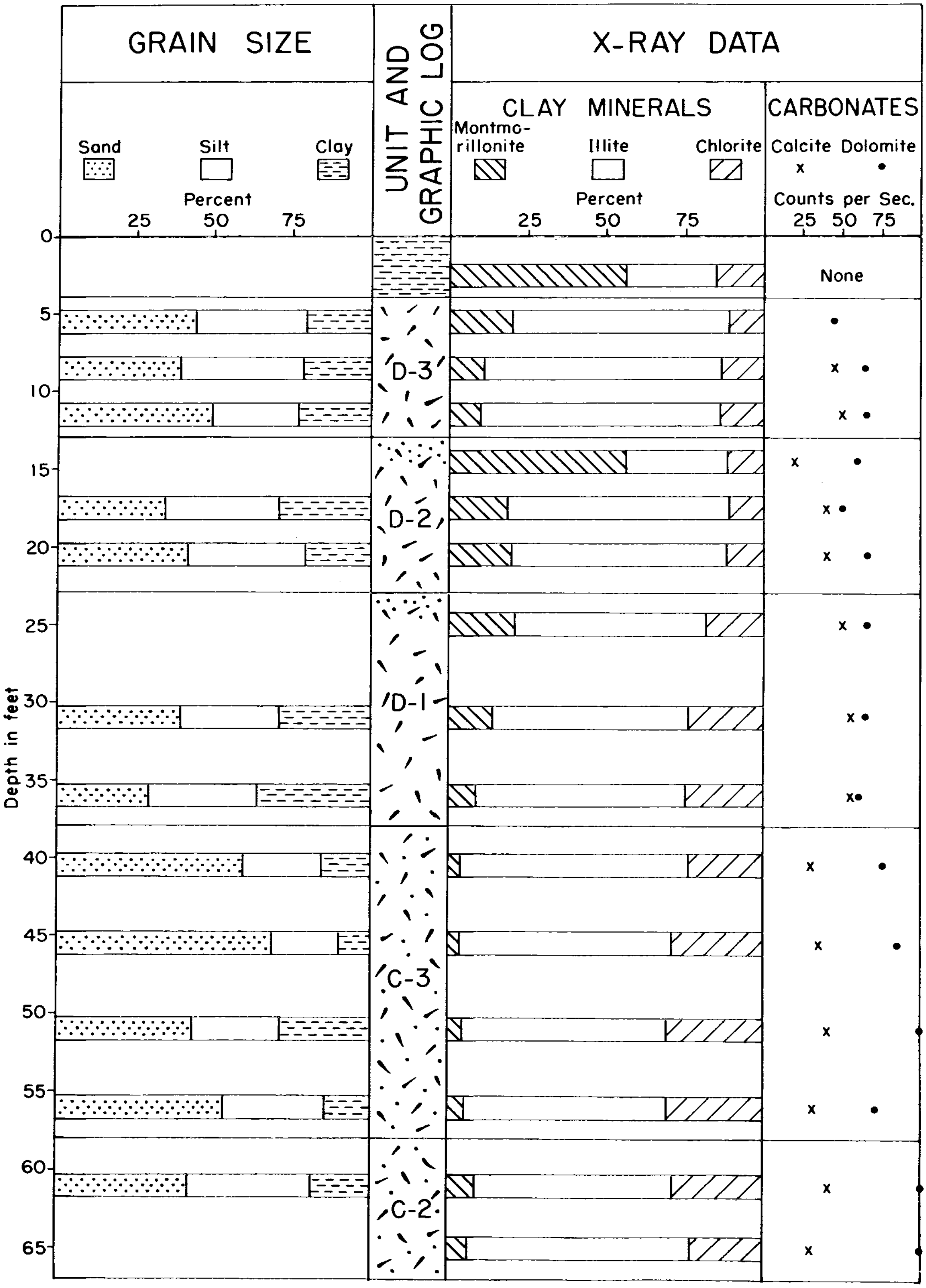


Fig. 12 - Percentage of sand, silt, and clay, with X-ray data for boring 29.

The average clay-mineral composition of the tills of Unit D is montmorillonite 7 percent, illite 64 percent, and chlorite 29 percent (table 3) and is similar to the tills of Units C and E. The sensitivity of the chlorite to the slightest weathering aids in separating the sub-units of Unit D. Alteration may be seen in the upper 22 feet along the toll highway where sampling is at a foot and a half interval, but it is difficult to recognize in samples representing 5 or 10 foot intervals from the water wells. The zone of clay-mineral alteration (e.g. boring 29, 13.5-15.0 feet, fig. 12, table 2) at the top of Sub-unit D-2, may represent weathering during a minor retreat of the ice. The only occurrence of kaolinite in Unit D is in Sub-unit D-3 in boring 28 (13.5-15.0 feet, table 2), but tills of Unit E in the Marengo end moraine to the east and northeast contain some kaolinite.

Several moraines are present behind the Shelbyville and in front of the Bloomington end moraines in central Illinois, and the sub-units in this area may record similar oscillations of the ice. Sub-unit D-3 may represent an advance of a later glacier, possibly an extension of the glacier that deposited Unit E to about the position of the White Rock end moraine. Some indication of this is the till sample in boring 28 (fig. 10, table 2), which overlies an organic-rich, partially leached sand.

Leighton (1923) assigned the drift in the outcrop area of Unit D to the Belvidere lobe and to an "Early Wisconsin" Substage. This was based primarily on the relatively shallow depth of leaching of the drift in comparison to that of the drift to the west (Unit C). Prior to this assignment, the drift generally had been mapped as Iowan (Leverett, 1899, p. 131) and considered intermediate between Illinoian and Wisconsinan. Shaffer (1954, 1956) correlated the drift with the Shelbyville drift of central Illinois. Horberg (1953, pl. 1, A-A', B-B') also identified Shelbyville drift in the subsurface under the Marengo and Bloomington drifts (Unit E).

The deposits of Unit D probably represent the earliest advance of the Woodfordian ice and are probably equivalent to Shelbyville and related pre-Bloomington drifts. However, the relations do not preclude the possibility that the thin patchy till of Sub-unit D-3 along the toll highway represents a somewhat later Woodfordian advance. On the other hand, Sub-unit D-3 could be the earliest Woodfordian deposit, and Sub-unit 1 and Sub-unit 2 could be Altonian in age.

Unit E.—This unit is primarily till of Woodfordian age. A greater silt and clay content of the till is diagnostic where it overlies older units. A typical section of the drift is described from samples taken from well 57 (0-55 feet, tables 2, 4). This unit is the surface drift of the Bloomington end moraine and is the exposed drift in DeKalb County south to the Cropsey end moraine (fig. 3). It is also the surface drift on Marengo Ridge to the east in Kane and McHenry Counties (fig. 3).

The till is pinkish gray to reddish gray (7.5YR 4/2 to 5YR 4/2) in color. Oxidized till of this unit is usually light pinkish brown or reddish brown (7.5YR 5/4 to 5YR 4/3). It is only slightly pebbly and is sand-silt-clay (figs. 14, 17) with an average of 38.2 percent sand, 37.2 percent silt, and 24.6 percent clay for all samples. Variations in grain size are generally minor within a vertical sequence of Unit E (e.g. well 68, fig. 8, table 2). The average percentage of sand, silt, and clay for each vertical sequence of the unit throughout the area remains consistent within narrow limits of the sand-silt-clay designation (figs. 14, 17).

The clay-mineral composition of the till of Unit E averages 6 percent montmorillonite, 63 percent illite, and 31 percent chlorite (table 3). The till of

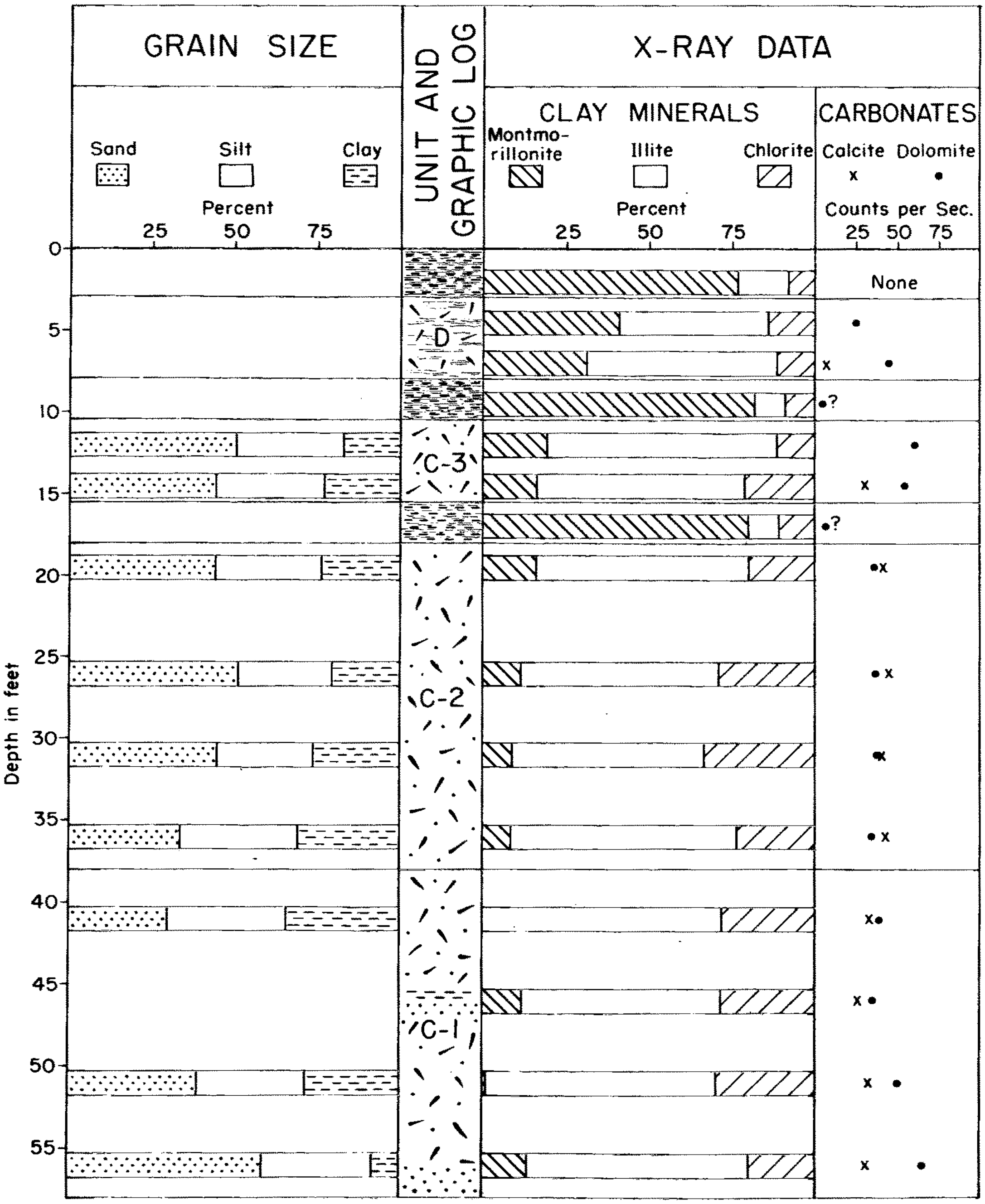


Fig. 13 - Percentage of sand, silt, and clay, and X-ray data for boring 40.

Unit E in Marengo Ridge is distinct in that kaolinite can be positively identified in most samples (borings 43, 44, 45, 47, table 2). Alteration of chlorite generally extends to a depth of 15 to 20 feet into the till where it crops out at the surface. Dolomite is normally leached to a depth of 3 to 4 feet from the surface, but calcite is leached to depths of 4 to 5 feet.

The drift of Unit E appears to be equivalent in age to the drift of the Bloomington Moraine in the type area in McLean County (fig. 3). West of this area in Bureau County, similar pinkish drift is assigned to three subdivisions of the Bloomington Moraine and to the Metamora Moraine (MacClintock and Willman, 1959).

Although there is doubt that the Marengo Moraine in western McHenry and Kane Counties is exactly contemporaneous with the Bloomington in DeKalb County (Leverett, 1899, p. 295), their drifts are similar (Unit E, figs. 14, 17). The Bloomington and Marengo end moraines in the study area appear to be composite moraines as only part of the major relief can be attributed to the drift of Unit E.

Unit F.—Woodfordian deposits that lie stratigraphically above Unit E are grouped as Unit F. They are distinct from Unit E in texture and color. Inadequate sampling precludes adequate identification and separation of these deposits throughout southeastern and southern DeKalb, eastern Lee, and northern LaSalle Counties, and along the eastern border of the study area. These deposits are present at the surface in southern DeKalb and southeastern Lee Counties.

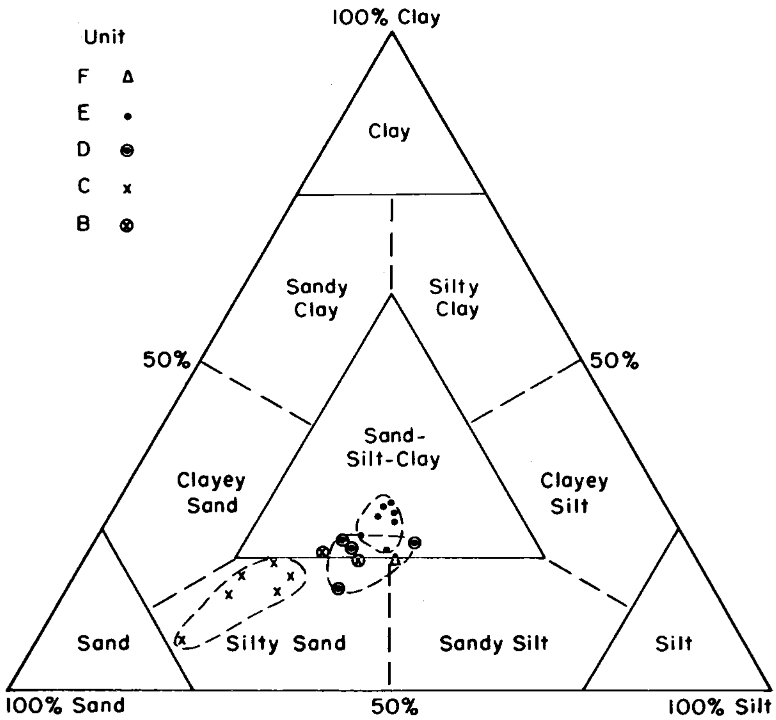


Fig. 14 - Grain size of till matrix from Units B-F sampled in water wells (classification after Shepard, 1954).

The drift of Unit F in southern DeKalb and southeastern Lee Counties (fig. 7) consists of till with a basal sand and gravel. The till is brown to grayish brown in color (10YR 4/3-4/2). It is oxidized to a depth of about 15 feet, and in this zone it has a reddish brown color (5YR 4/3). Two samples of the till (well 70) are sandy silt with an average of 40 percent sand, 41 percent silt, and 19 percent clay (fig. 14). The maximum thickness of Unit F in this area is about 85 feet.

In northwestern Kane County, Unit F is a very gravelly and sandy drift that is yellowish brown in color (10YR 5/4-4/4) and in boring 47 is oxidized throughout the entire thickness of about 25 feet.

The drift in northwestern McHenry County (e.g. well 85, table 4) consists of a "red" gravelly till as reported in driller's logs in the area. Without quantitative information, the presence of Unit F can be inferred only from topographic features and previous surface mapping.

The drift included in Unit F in southern DeKalb and southeastern Lee Counties represents deposits of the ice that formed the Cropsey end moraine (fig. 3). The drift above Unit E on the back slope of Marengo Ridge in northwestern Kane County (well 47, fig. 11) has been mapped as the Gilberts Moraine by Ekblaw (Suter et al., 1959, fig. 5). The drift of Unit F in northwestern McHenry County is the West Chicago Moraine of the Valparaiso morainic complex.

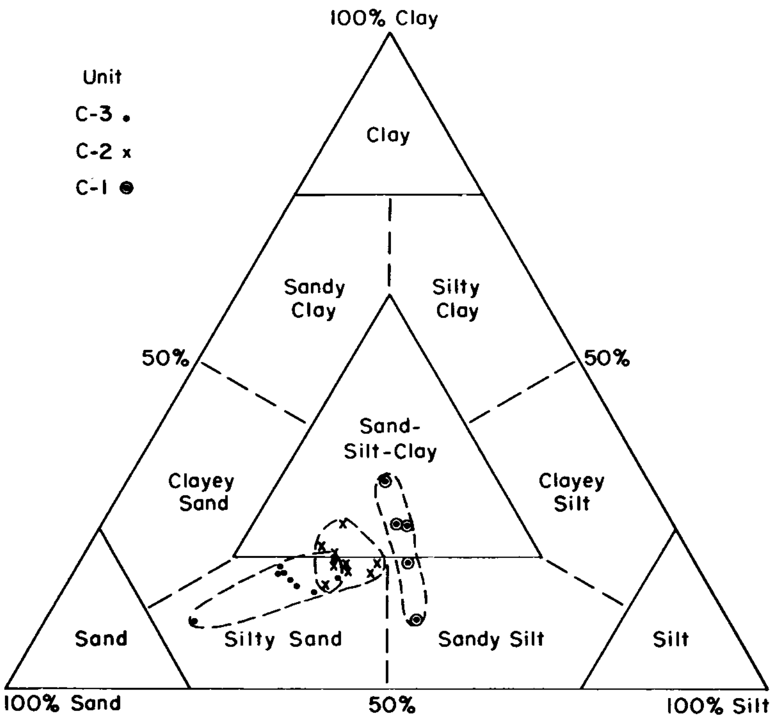


Fig. 15 - Grain size of till matrix from sub-units of Unit C from core samples along Northwest Toll Highway.

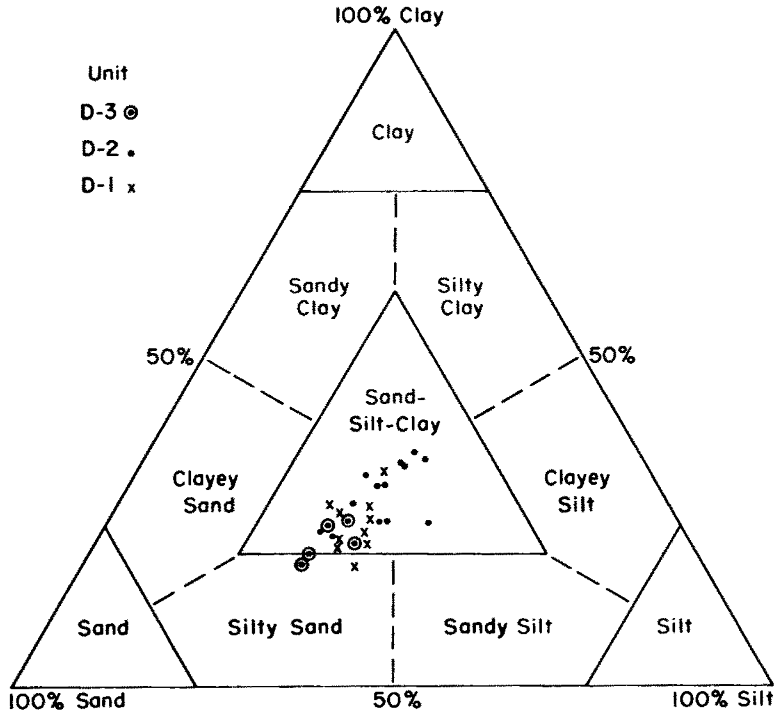


Fig. 16 - Grain size of till matrix from sub-units of Unit D from core samples along Northwest Toll Highway.

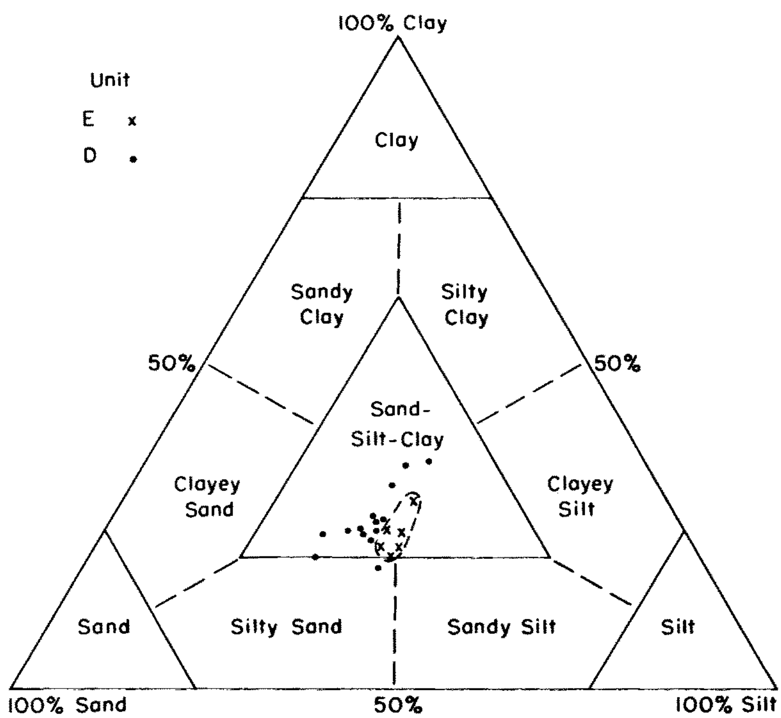


Fig. 17 - Grain size of till matrix from Units D and E from core samples along Northwest Toll Highway.

SUMMARY

Cores from closely spaced borings along the Northwest Toll Highway and samples from water wells provided an unusual opportunity to study variations in the glacial drift of central northern Illinois. The lithology of the samples was studied by quantitative methods and the mineral composition was determined by X-ray analyses. The principal conclusions from this study are as follows:

1) Many lithologic units can be differentiated and traced in the drift of the area.
2) A basal sand in the lower part of Troy Valley is similar to the Sankoty Sand found in the major buried bedrock valleys throughout the state. It is probably pre-Illinoian in age.
3) A tongue of ice probably Illinoian in age pushed into the Troy Valley from the south and reached into northern DeKalb County.
4) The Winnebago drift consists of deposits of at least three glacial advances, the last two separated by an interstadial that was possibly 6,000 or more radiocarbon years long and extended from more than 38,000 to about 31,800 years B.P.
5) Troy Valley served as a drainageway until the beginning of the Woodfordian Substage when portions of the valley were completely filled by drift.
6) The moraines of the area are complex and consist of several till sheets resulting from fluctuations of the ice front.
7) Troy Valley contains locally thick, permeable sand and gravel deposits, but they are less extensive than previously believed.

TABLE 1 - LIST OF REFERENCE BORINGS AND WELLS

Boring or well	Location† Number	Elevation	Boring or well	Location Number	Elevation	Boring or well	Location Number	Elevation
Borings 1-47 drilled for Northwest Toll Highway by Westville Engineering Company; core study records								
	WIN = Winnebago			BNE = Boone				
1	WIN 44N2E-2.2e	890.7	18	BNE = 43N3E-31.1b	760.1	34	BNE 43N4E-10.2e	799.9
* 2	WIN 44N2E-11.2i	885.4	19	BNE = 43N3E-5.8h	758.4	35	BNE 43N4E-13.7	795.2
3	WIN 44N2E-11.2h	877.0	20	BNE = 43N3E-4.8e	761.1	36	BNE 43N4E-13.6	784.0
4	WIN 44N2E-11.2e	904.8	21	BNE = 43N3E-4.3d	763.0	37	BNE 43N4E-13.1f	800.4
* 5	WIN 44N2E-14.2e	891.4	22	BNE = 43N3E-4.1d	769.0		MCH = McHenry	
6	WIN 44N2E-14.2d	896.0	23	BNE = 43N3E-3.1d	790.9			
7	WIN 44N2E-14.2c	895.0	24	BNE = 43N3E-2.3d	783.0	38	MCH 43N5E-21.8g	805.6
8	WIN 44N2E-14.2a	860.0	25	BNE = 43N3E-2.1d	795.0	39	MCH 43N5E-22.3a	805.0
9	WIN 44N2E-23.2g	847.5	26	BNE = 43N3E-1.7d	803.0	*40	MCH 43N5E-26.5f	822.0
10	WIN 44N2E-23.2d	892.2	27	BNE = 43N3E-1.3d	828.2		KNE = Kane	
*11	WIN 44N2E-23.2b	836.7	*28	BNE = 43N4E-6.8d	850.0			
12	WIN 44N2E-35.2i	821.1	*29	BNE = 43N4E-6.7d	844.5	*41	KNE 43N6E-31.6c	845.0
13	WIN 44N2E-36.8e	788.4	30	BNE = 43N4E-6.4d	855.0	42	KNE 43N6E-32.6c	864.0
14	WIN 44N2E-36.7d	783.9	31	BNE = 43N4E-5.2d	810.9	43	KNE 42N6E-4.3g	876.5
15	WIN 44N2E-36.4d	784.0	32	BNE = 43N4E-4.4b	773.0	44	KNE 42N6E-3.8e	875.0
16	WIN 44N2E-36.2d	728.1	33	BNE = 43N4E-10.8h	800.3	45	KNE 42N6E-3.2c	903.1
17	WIN 44N2E-36.1d	724.3				46	KNE 42N6E-2.7b	947.3
						47	KNE 42N6E-12.5g	926.3

Boring or well	Location Number	Drilled for	Driller	Date	Type of Record	Elevation
48	MCH 43N6E-4.5f	Union Village (1)	P. E. Millis	1934	SS 1493	835
49	MCH 43N6E-7.5a	Arthur Purky	Silvis Bros.	1960	SS35326	915
	DEK = DeKalb					
50	DEK 41N5E-2.5g	Melvin Westlake	Leon Butts	1960	SS35950	879
*51	DEK 41N5E-29.1f1	Robert Milligan	Leon Butts	1959	SS34986	845
52	DEK 41N4E-13.8h	Kishwaukee Country Club	H. I. Stone	1958	SS31095	870
53	DEK 39N3E-24.1h	Harris Fisk	A. W. Broughton	1959	SS34547	863
54	WIN 43N2E-25.9a	William Rich	H. L. Prentice	1955	Driller's log	760
55	DEK 41N3E-14.5g	Francis Burgweger	?	1945	Driller's log	860
56	DEK 41N3E-24.1e	John J. Scheffers	Leon Butts	1959	SS34700	870
*57	DEK 41N3E-36.1g	Grover Ashelford	Leon Butts	1960	SS36331	882
58	DEK 40N4E-6.3d	William P. Hoyt	H. L. Prentice	1954	Driller's log	885
59	{DEK 40N3E-13.7a	P. T. Wright	H. L. Prentice	1940	Driller's log	912
	{DEK 40N3E-24.7h	Mrs. P. T. Wright	H. L. Prentice	1953	Driller's log	911
60	DEK 39N3E-1.1h	Willrett	H. L. Prentice	1939	Driller's log	872
*61	DEK 38N3E-3.4h	George Smith	A. W. Broughton	1961	SS40481	891
62	DEK 38N3E-16.2d	Louis Jakes	A. W. Broughton	1959	SS34987	905
63	DEK 38N3E-16.5a	Howard Mullins	A. W. Broughton	1960	SS35328	922
64	DEK 38N3E-28.7h	Mrs. Elsie B. Schrader	Leon Butts	1953	Driller's log	890
	LAS = LaSalle					
66	LAS 36N2E-13.5h	Northern Illinois Gas Storage	Vickery Company	1958	SS31653	710
	OGL = Ogle					
66	OGL 40N2E-14.1d	John Luxton	A. W. Broughton	1960	SS35951	865
67	DEK 40N3E-6.2a	Orville Baker	Leon Butts	1959	SS34467	900
*68	DEK 41N4E-26.7g	Ernest Rote	Leon Butts	1960	SS37261	853
69	DEK 40N5E-12.5c	Albert Hinkle	Leon Butts	1960	Driller's log	858

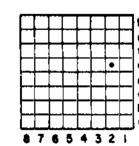
*70	DEK 38N3E-27.4g	Robert E. Shubert	Leon Butts	1961	SS38847	897
71	DEK 38N4E-20.2h	Ed Rueff	A. W. Broughton	1959	SS34692	880
72	DEK 38N5E-36.5a	Northern Illinois Gas Storage	Vickery Company	1958	SS32512	710
73	MCH 46N5E-8.5f	George Lamb	Lucy H. VanHoozen	1941	Driller's log, SS 6397	982
74	MCH 46N5E-19.8d	Frank D. Graf	Lucy H. VanHoozen	1940	Driller's log	922
75	BNE 45N4E-2.1a	Lowell Wegner	A. L. Bottlemy	1960	SS ?	924
76	BNE 45N3E-36.5a	Johnson	Ken Schmalz	1960	Driller's log	857
*77	BNE 45N4E-6.8e	North Boone High School	Allabaugh Company	1955	SS25879	950
78	BNE 46N4E-19.1b	Borg	Lucy H. VanHoozen	1940	Driller's log	980
79	BNE 46N4E-14.8a	August Walters	Lucy H. VanHoozen	1942	Driller's log	944
80	MCH 46N5E-20.8d	W. J. Goodman	Lucy H. VanHoozen	1941	Driller's log, SS 7199	932
81	MCH 46N5E-16.1h	E. B. McQuinn 2	Lucy H. VanHoozen	1943	SS 9831	920
82	MCH 46N5E-12.5e	Frank Raupp	A. L. Bottlemy	?	Driller's log	980
83	MCH 46N6E-17.7a	Richard Zenka	Lucy H. VanHoozen	1945	Driller's log	1100
84	MCH 46N6E-21.8h	Jasper King	Lucy H. VanHoozen	1944	Driller's log	1045
*85	MCH 46N6E-10.5d	N. B. Clawson	Lucy H. VanHoozen	1941	SS 7193	1052
86	Wisc.: Walworth 1N17E-20.7f	George Mervin	A. L. Bottlemy	?	Driller's log	1076
87	MCH 46N5E-10.7a	H. M. Marsh	Lucy H. VanHoozen	1941	SS 7197	923
88	BNE 45N3E-15.1c	Roy Lundberg	George A. Schmalz	1944	Driller's log	942
89	DEK 40N3E-4.1d	J. B. Willrett	H. L. Prentice	1954	Driller's log	916
90	DEK 41N4E-28.5g	Bud Smith	Wm. Tyrell & Son	1960	Driller's log	890
91	DEK 41N5E-35.3e	Lowell Trust & Savings	H. L. Prentice	1952	Driller's log	898
92	DEK 40N5E-12.6h	Leonard Larson	Leon Butts	1952	Driller's log	866
93	LEE 38N2E-36.3f	Equitable Life	T. Anderson	1941	Driller's log	970
94	DEK 38N4E-16.2d	Village of Waterman	J. P. Miller	1946	Driller's log	820
95	DEK 38N4E-14.8g	Don Sawyer	H. L. Prentice	1955	Driller's log	792
96	DEK 38N4E-13.3h	Mrs. M. W. Greeley	H. L. Prentice	1956	Driller's log	772
97	DEK 38N5E-18.7c	Ed Kahle	H. L. Prentice	1941	Driller's log	752
98	DEK 38N5E-15.7e	Elmer Carls	Leon Butts	1959	SS33795	742
99	DEK 38N5E-15.1d	Old Tavern	?	1945	Driller's log	744
100	DEK 38N5E-26.5f	Harley Brewer	Leon Butts	1954	Driller's log	752
101	DEK 38N5E-36.5c	E. W. Hupp	Leon Butts	1955	Driller's log	709

* Samples described in table 4.

† The location numbering system used is based on the location of the well, and uses the township, range, and section for identification.

The location number consists of five parts: county abbreviation, township, range, section, and coordinate within the section. Sections are divided into rows of one-eighth mile squares. Each one-eighth mile square contains 10 acres and corresponds to a quarter of a quarter of a quarter section. A normal section of one square mile contains eight rows of eighth-mile squares; an odd-size section contains more or fewer rows. Rows are numbered from east to west and lettered from south to north as shown.

Winnebago County
T. 44 N., R. 2 E.,
Sec. 2



The number of the well shown in sec. 2 above is WIN 44N2E-2.2e

TABLE 2 - GRAIN-SIZE AND MINERAL ANALYSES

Depth (feet)	Grain size (percent)				Mineral X-ray Analyses (-2 micron fraction)					
	+2mm	-2mm			Clay Minerals (percent)				Carbonates (counts per second)	
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 1										
0.0- 1.5					79	13	8	+	-	?
3.0- 4.5	8.0	4.8	75.0	20.2	79	12	9	+	-	24
6.0- 7.5	7.4	46.7	36.5	16.8	60	32	8	-	-	90
9.0-10.5	7.6	47.2	35.5	17.3	55	40	5	-	12	95
12.0-13.5	6.5	50.7	32.7	16.6	28	64	8	-	35	65
15.0-16.5	6.6	46.4	33.7	19.9	11	67	22	-	42	60
18.0-19.5	7.0	47.3	31.1	21.6	11	72	17	-	50	70
19.5								-	12	95
Boring No. 2										
1.5- 3.0					85	9	6	+	-	-
4.5- 6.0	5.7	10.7	71.4	17.9	81	13	6	+	-	-
7.5- 9.0					90	5	5	+	-	-
10.5-12.0	8.2	55.4	27.2	17.4	33	56	11	-	30	55
13.5-15.0					81	12	7	+	-	-
16.5-18.0					21	66	13	-	11	45
19.5-21.0					14	70	16	-	12	50
Boring No. 4										
7.5- 9.0	11.0	62.7	26.0	11.3						
10.5-12.0	6.3	55.5	25.6	18.9						
13.5-15.0	7.8	53.8	27.4	18.8						
16.5-18.0	8.0	54.0	26.7	19.3						
19.5-21.0	7.3	53.7	27.2	19.1						
25.0-26.5	9.6	51.4	28.5	20.1						
Boring No. 5										
1.5- 3.0					59	24	17	+	-	10
4.5- 6.0					78	12	10	+	-	?
7.5- 9.0					63	24	13	+	-	18
10.5-11.0					40	33	27	+	-	9
11.0-11.5					51	29	20	+	-	-?
11.5-12.0					44	26	30	+	-	-
13.5-15.0					77	8	15	+	-	-
16.5-17.5					85	6	9	+	-	-
17.5-18.0					72	13	17	+	-	?
19.5-21.0					35	51	14	-	-	85
25.0-26.5	6.4	56.5	26.6	16.9	21	53	26	-	50	70
30.0-31.0	10.4	52.5	27.7	19.8	11	61	28	-	60	75
Boring No. 11										
1.5- 3.0					74	15	11	+	-	-
4.5- 6.0					27	65	8	-	?	35
7.5- 9.0	8.3	55.0	27.8	17.2	21	68	11	-	40	50
10.5-12.0	7.8	55.2	28.5	16.3	20	70	10	-	32	48
13.5-15.0	9.6	53.7	28.4	17.9	14	74	12	-	40	40
16.5-18.0	8.7	55.4	27.9	16.7	9	76	15	-	28	55
19.5-21.0	7.7	56.4	27.7	15.9	14	70	16	-	55	65

TABLE 2 - Continued

Depth (feet)	Grain Size (percent)				Mineral X-ray Analyses (-2 micron fraction)					
	+2mm	-2mm			Clay Minerals (percent)				Carbonates (counts per second)	
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 11 cont.										
25.0-26.5	12.6	53.1	29.8	17.1	8	75	17	-	45	60
30.0-31.5	8.6	52.4	30.7	16.9	7	68	25	-	45	55
35.0-36.5	11.5	53.1	31.1	15.8	7	67	26	-	34	46
40.0-40.5	12.8	47.6	35.3	17.1	2	73	25	-	15	45
40.5-41.5	12.1	45.6	35.8	18.6	3	77	20	-	12	30
45.0-46.5					16	67	17	-	25	60
49.0-50.5					3	74	23	-	20	45
60.0-61.5					2	74	24	-	20	80
61.5-62.0					3	77	20	-	20	55
62.5-64.0	31.4	38.1	42.7	19.2	7	75	18	-	22	40
70.0-71.5					8	72	20	-	22	50
Boring No. 12										
7.5- 9.0	8.8	57.9	26.4	15.7						
10.5-12.0	7.3	56.4	25.7	17.9						
13.5-15.0	7.7	55.3	25.6	19.1						
16.5-18.0	5.0	53.6	27.5	18.9						
19.5-21.0										
25.0-26.5	6.6	53.0	28.3	18.7						
30.0-31.5	10.5	53.6	27.2	19.2						
35.0-36.5	6.8	47.8	30.4	21.8						
40.0-41.5	7.7	48.0	30.4	21.6						
Boring No. 15										
1.5- 3.0					62	24	14	+	-	-
4.5- 6.0					14	83	3	-	-	-
7.5- 9.0					14	75	11	-	-	15
10.5-12.0					16	75	9	-	?	25
13.5-15.0					11	80	9	-	20	45
16.5-18.0					11	77	12	-	12	45
19.5-21.0					12	77	11	-	50	65
25.0-26.5	5.7	50.8	28.9	20.3	15	73	12	-	40	65
30.0-31.5	7.0	50.0	29.1	20.9	14	74	12	-	40	65
Boring No. 16										
19.5-21.0					14	72	14	-	8	42
30.0-31.5	1.1	34.5	41.5	24.0	-	72	28	-	5	30
35.0-36.5	6.6	36.5	38.3	25.2	-	71	29	-	-	24
40.0-41.5					4	83	13	-	14	70
45.0-46.5					4	86	10	-	14	50
Boring No. 23										
1.5- 3.0					53	33	14	-	-	-
4.5- 6.0	1.5	28.8	36.8	34.4	10	74	16	-	40	45
7.5- 9.0					14	68	18	-	25	65
10.5-12.0					10	75	15	-	22	75
13.5-15.0	1.3	52.8	38.7	8.5	24	57	19	-	30	75
16.5-18.0					16	66	18	-	25	120

TABLE 2 – Continued

Depth (feet)	Grain Size (percent)				Mineral X-ray Analyses (–2 micron fraction)					
	+2mm	–2mm			Clay Minerals (percent)				Carbonates (counts per second)	
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 23 cont.										
19.5–21.0					15	71	14	–	25	95
Boring No. 24										
1.5– 3.0					75	15	10	+?	–	25
4.5– 6.0	–	0.3	35.5	64.2	12	68	20	–	30	55
7.5– 9.0					16	57	27	–	35	75
10.5–12.0	8.2	56.6	32.2	11.2	12	62	26	–	30	55
13.5–15.0	1.1	32.0	34.1	33.9	8	62	30	–	40	45
16.5–18.0					12	60	28	–	25	70
19.5–21.0								–	50	110
25.0–26.5	1.1	73.5	16.7	9.8	14	61	25	–	45	70
Boring No. 25										
1.5– 3.0					64	25	11	+	–	–
4.5– 6.0					22	68	10	+?	10	65
7.5– 9.0	3.9	50.0	28.8	21.2	17	66	17	–	20	65
10.5–12.0					14	68	18	–	20	65
13.5–15.0	6.4	45.4	28.4	26.2	5	86	9	–	40	95
16.5–18.0	1.2	54.2	33.9	11.9	8	76	16	–	20	75
19.5–21.0								–	17	75
Boring No. 26										
1.5– 3.0					59	29	12	+	–	–
4.5– 6.0	0	0.8	17.4	81.8	15	72	13	–	30	55
7.5– 9.0	1.4	57.0	34.1	0.9	16	61	23	–	20	55
10.5–12.0	4.0	29.9	34.6	35.5	15	66	19	–	35	35
13.5–15.0	0	57.8	38.8	3.4	11	63	26	–	17	95
16.5–18.0	4.7	47.4	34.1	18.5	11	65	24	–	28	65
19.5–21.0	3.0	44.5	37.3	18.2	13	66	21	–	30	70
25.0–26.5					5	70	25	–	33	70
30.0–31.5	7.4	57.7	32.3	10.0	8	68	24	–	35	120
35.0–36.5					8	73	19	–	20	80
Boring No. 27										
1.5– 3.0					45	39	16	+?	–	–
4.5– 6.0					5	84	11	–	–	–
7.5– 9.0					40	50	10	–	–	50
10.5–12.0					30	51	19	–	40	80
13.5–15.0					47	33	20	–	40	65
16.5–18.0	5.0	41.3	32.5	26.2	9	66	25	–	55	65
19.5–21.0	2.6	35.2	33.9	30.9	9	64	27	–	50	70
25.0–26.5	2.7	33.1	32.1	34.8	11	63	26	–	40	70
30.0–31.5	17.4	41.0	29.8	29.2	7	63	30	–	55	70
35.0–36.5	3.2	46.5	33.5	20.0				–		
40.0–41.5	8.0	46.7	35.5	17.8				–	35	85
45.0–46.5	2.3	35.6	43.9	20.5				–		
50.0–51.5	7.1	51.1	36.3	12.6				–		

TABLE 2 – Continued

Depth (feet)	Grain size (percent)				Mineral X-ray Analyses (–2 micron fraction)					
					Clay Minerals (percent)				Carbonates (counts per second)	
	+2mm	–2mm								
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 28										
1.5– 3.0								–	–	10
4.5– 6.0								–	–	–
7.5– 9.0								–	–	40
10.5–12.0								–	15	75
13.5–15.0	6.7	51.1	28.9	20.0	15	59	26	+	32	60
16.5–18.0								–	–	24
19.5–21.0								–	–	20
Boring No. 29										
1.5– 3.0					56	29	15	+	–	–
4.5– 6.0	4.7	44.4	35.5	20.1	20	69	11	–	–	45
7.5– 9.0	4.1	39.6	38.4	22.0	11	76	13	–	45	65
10.5–12.0	6.1	49.4	27.8	22.8	10	76	14	–	50	65
13.5–15.0					56	32	12	–	20	60
16.5–18.0	4.3	34.8	35.7	29.5	18	71	11	–	40	50
19.5–21.0	8.3	41.8	37.3	20.9	20	68	12	–	40	65
24.0–25.5					21	61	18	–	50	65
30.0–31.5	3.1	39.8	30.6	29.6	14	62	24	–	55	65
35.0–36.5	3.6	29.7	33.9	36.4	8	67	25	–	55	60
40.0–41.5	12.2	59.6	25.0	15.4	3	73	24	–	30	75
45.0–46.5	1.8	67.4	22.5	10.1	3	68	29	–	35	85
50.0–51.5	1.1	43.0	28.3	28.7	4	65	31	–	40	100
55.0–56.5	5.7	53.0	32.2	14.8	5	64	31	–	30	70
60.0–61.5	4.3	42.1	39.1	18.8	8	63	29	–	40	100
64.0–65.5					6	71	23	–	30	100
Boring No. 30										
1.0– 2.0									–	–
3.0– 4.0					38	47	15	–	–	–
5.0– 6.0	1.2	12.2	43.5	44.3	7	83	10	–	18	85
7.0– 8.0					29	58	13	–	–	55
11.0–12.0					14	70	16	–	40	70
16.0–17.0	5.4	52.9	28.4	18.7	18	60	22	–	40	80
21.0–22.0	3.4	39.9	35.7	24.4	6	62	32	–	50	80
26.0–27.0					10	62	28	–	50	85
31.0–32.0	3.0	39.4	35.6	25.0	12	60	28	–	35	55
36.0–37.0	3.3	38.4	35.7	25.9					45	80
40.0–41.0	4.2	48.0	30.8	21.2					40	60
46.0–47.0	2.9	43.8	31.9	24.3					50	75
Boring No. 31										
1.5– 3.0					19	71	10	–	–	40
4.5– 6.0					54				–	35
7.5– 9.0	3.2	43.1	37.4	19.5	19	66	15	–	55	70
10.5–12.0	4.5	39.2	34.5	26.3	11	66	23	–	35	70
13.5–15.0	4.4	42.4	35.0	22.6	10	65	25	–	60	70
16.5–18.0	3.7	41.2	36.1	22.7	11	60	20	–	45	70

TABLE 2 - Continued

Depth (feet)	Grain Size (percent) +2mm Gravel	Grain Size (percent) -2mm Sand	Silt	Clay	Mineral X-ray Analyses (-2 micron fraction) Clay Minerals (percent) Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Carbonates (counts per second) Calcite	Dolomite
Boring No. 31 cont.										
19.5-21.0					10	63	27	-	30	80
25.0-26.5	8.8	49.1	31.8	19.1	5	69	26	-	30	105
30.0-31.5	5.7	38.1	37.8	24.1	-	69	31	-	50	85
35.0-36.5					11	56	33	-	40	85
40.0-41.5	1.4	59.0	27.2	13.8	8	66	26	-	40	80
45.0-46.5					4	73	23	-	30	110
50.0-51.5	1.0	58.6	25.2	16.2	5	69	26	-	35	90
54.0-55.5	1.2	51.5	30.2	18.3	6	69	25	-	40	100
Boring No. 32										
1.5- 3.0					79	12	9	+	-	?
4.5- 6.0					74	14	12	+	-	?
7.5- 9.0					28	47	25		10	100
10.5-12.0					17	67	16		17	140
13.5-15.0					13	65	22		15	105
16.5-18.0	7.0	51.7	32.5	15.8	5	71	24		35	80
19.5-21.0	9.8	51.1	33.3	15.6	5	79	16		5	30
30.0-31.0	18.3	36.6	38.2	25.2	12	67	21		40	95
Boring No. 33										
1.5- 3.0					70	20	10	+	-	-
4.5- 6.0	4.7	39.1	36.3	24.6	26	62	12	-	30	65
7.5- 9.0	7.0	36.1	33.6	30.3	20	68	12	-	40	55
10.5-12.0	11.4	51.0	26.5	22.5	33	56	11	-	26	65
13.5-15.0	2.8	44.2	30.5	25.3	22	64	14	-	37	40
16.5-18.0	3.2	45.2	30.9	23.9	25	60	15	-	30	75
19.5-21.0					8	63	29	-	33	44
25.0-26.5	8.1	42.7	35.0	22.3	11	58	31	-	50	65
30.0-31.5	2.8	40.1	39.3	20.6	18	55	27	-	32	50
35.0-36.5	7.2	55.3	28.6	16.0	7	63	30	-	48	65
40.0-41.5	6.9	85.8	10.4	3.8	6	72	22	-	37	85
45.0-46.5					0	90	10	-	15	100
50.0-51.5	6.1	42.1	47.0	10.9	6	76	18	-	30	85
55.0-56.5	4.5	40.8	49.1	10.1	9	73	18	-	40	120
Boring No. 34										
1.5- 3.0					64	26	10	+	-	-
4.5- 6.0	1.9	43.2	36.3	20.5	16	75	9	-	-	28
7.5- 9.0	8.8	33.3	36.9	29.8	14	75	11	-	12	55
10.5-12.0	2.8	28.5	39.3	32.2	12	77	11	-	38	60
13.5-15.0	3.9	46.9	28.5	24.6	8	64	28	-	35	45
16.5-18.0	6.7	43.6	30.1	26.3	4	64	32	-	38	55
19.5-21.0	5.7	44.1	31.3	24.6	7	63	30	-	40	42
25.0-26.5	5.4	33.3	46.7	20.0	6	68	26	-	30	80
30.0-31.5					5	73	22	-	35	70
35.0-36.5	-	11.0	49.1	39.9	4	73	23	-	35	75
40.0-41.5					9	66	25	-	32	75

TABLE 2 - Continued

Depth (feet)	Grain Size (percent) +2mm Gravel	-2mm Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
					Mineral X-ray Analyses (-2 micron fraction): Clay Minerals (percent)				Carbonates (counts per second)	
Boring No. 34 cont.										
45.0-46.5					4	75	21	-	40	85
50.0-51.5					9	69	22	-	35	110
Boring No. 35										
1.5- 3.0					53	40	7	+?	-	-
4.5- 6.0					15	69	16	-	45	60
7.5- 9.0					21	65	14	-	28	45
10.5-12.0	1.1	46.4	29.0	24.6	15	73	12	-	40	55
13.5-15.0	4.0	31.4	35.6	33.0	15	60	25	-	50	65
16.5-18.0	4.7	31.8	33.3	34.9	16	59	25	-	45	48
22.0-23.5	5.4	32.6	33.8	33.6	7	61	32	-	32	45
25.0-26.5	3.4	32.3	32.0	35.7	7	60	33	-	40	50
30.0-31.5					2	60	38	-	30	85
35.0-36.5	1.3	39.2	38.2	22.6	4	68	28	-	20	45
39.5-41.0					3	64	33	-	28	55
45.0-46.5					2	68	30	-	25	70
50.0-51.5	4.9	46.1	39.0	14.9	3	77	20	-	30	80
Boring No. 36										
1.5- 3.0					91	5	4	+	-	-
4.5- 6.0					64	21	15	+	-	8
7.5- 9.0					34	43	23	?	30	55
10.5-12.0					45	38	17	+	40	55
13.5-15.0					57	28	15	+	?	22
16.5-18.0	7.5	57.7	28.1	14.2	18	61	21	-	30	75
19.5-21.0	8.7	50.7	32.0	17.3	6	64	30	-	25	60
25.0-26.5	7.4	47.3	33.6	19.1	6	76	18	-	32	85
30.0-31.5	9.0	47.8	34.1	18.1	3	72	25	-	22	55
35.0-36.5	6.7	42.7	37.1	20.2	3	71	26	-	22	55
40.0-41.5					2	73	25	-	25	90
Boring No. 37										
1.5- 3.0					56	34	10	+	-	-
4.5- 6.0					53	37	9	+	-	-
7.5- 9.0					6	83	11	+?	-	60
10.5-12.0					10	72	18	+?	30	45
13.5-15.0	5.4	32.8	42.0	25.2	7	67	26	-	50	70
16.5-18.0					5	68	27	-	50	65
19.5-21.0	4.0	47.2	32.9	19.9	5	67	28	-	33	50
25.0-26.5	2.2	47.9	40.5	11.5	13	64	23	-	35	60
26.5-28.0	4.1	45.6	37.9	16.5	7	68	25	-	25	40
30.0-31.5					6	69	25	-	35	100
35.0-36.5					6	70	24	-	30	75
40.0-41.5					8	69	23	-	30	95
45.0-46.5	1.1	54.7	30.5	14.8	3	80	17	-	30	75
Boring No. 38										
1.5- 3.0	3.0	47.3	22.9	29.8	30	61	9	-	-	-

TABLE 2 – Continued

Depth (feet)	Grain Size (percent)				Mineral X-ray Analyses (–2 micron fraction)					
	+2mm	–2mm			Clay Minerals (percent)				Carbonates (counts per second)	
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 38 cont.										
4.5– 6.0	3.2	44.0	37.0	19.0	25	61	14	–	17	47
7.5– 9.0	4.6	45.8	31.8	22.3	23	64	13	–	32	50
10.5–12.0	1.2	47.2	31.3	21.4	20	65	15	–	30	40
13.5–15.0	5.9	46.4	35.9	17.7	18	65	17	–	25	35
16.5–18.0	5.4	34.5	32.1	33.3	20	65	15	–	35	45
19.5–21.0	7.9	52.6	32.9	14.5	19	61	20	–	30	70
25.0–26.5	1.9	47.7	33.3	18.9	6	74	20	–	20	80
30.0–31.5					6	73	21	–	35	90
Boring No. 39										
19.5–20.0	6.7	16.2	63.7	20.1						
20.0–21.0	8.6	44.7	35.0	20.3	4	64	32	–	40	75
25.0–26.5					7	60	33	–	60	100
30.0–31.5	6.5	50.3	29.3	20.4	7	64	29	–	32	50
Boring No. 40										
1.0– 2.5					77	15	8	+	–	–
3.5– 5.0					41	45	14	–	–	25
6.0– 7.5					31	57	12	+	6	45
8.5–10.0					82	9	9	+	–	5?
11.0–12.5	6.9	50.3	32.5	17.2	19	69	12	+	–	60
13.5–15.0	5.6	44.7	32.5	22.8	16	63	21	?	30	55
16.5–17.5					80	9	11	+	–	7?
18.5–20.0	5.3	44.6	32.3	23.1	16	64	20	–	40	37
25.0–26.5	1.6	51.7	28.1	20.2	12	59	29	+	44	37
30.0–31.5	4.7	45,1	28.7	26.2	9	58	33	+	40	38
35.0–36.5	5.1	33.5	35.6	30.9	8	68	24	–	42	34
40.0–41.5	4.7	30.1	35.3	34.6	–	72	28	+	32	37
45.0–46.5					12	60	28	+	25	35
50.0–51.5	4.5	39.3	32.5	28.2	2	68	30	?	32	50
55.0–56.5	7.1	59.0	28.1	12.9	13	67	20	–	30	65
Boring No. 41										
25.0–26.5					9	60	31	–	25	55
36.5–37.3					82	8	10	+?	–	–
37.3–38.1					80	8	12	+?	–	7?
38.1–39.5					13	61	26	–	–	90
Boring No. 43										
1.5– 3.0					48	32	20	+?	–	10
3.5– 5.0					27	60	13	?	–	100
6.0– 7.5					21	64	15	–	?	65
8.5–10.0					20	64	16	–	28	70
11.0–12.5	5.4	38.3	34.7	27.0	22	65	13	?	35	75
13.5–15.0	2.9	35.5	39.3	25.2	26	62	12	?	28	55
16.0–17.5	2.9	34.6	38.9	26.5	12	63	25	+?	28	50
18.5–20.0					8	64	28	?	30	65
25.0–26.5	5.1	36.6	37.5	25.9	8	63	29	?	45	65

TABLE 2 – Continued

Depth (feet)	Grain Size (percent)				Mineral X-ray Analyses (–2 micron fraction)					
	+2mm	–2mm			Clay Minerals (percent)				Carbonates (counts per second)	
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 43 cont.										
30.0–31.5	5.0	48.5	33.7	17.8						
35.0–36.5					8	68	24	–	45	135
40.0–41.5					8	65	27	–	35	80
Boring No. 45										
1.0– 2.5					20	56	24	+	?	15
3.5– 5.0	7.9	46.1	37.3	16.6	17	66	17	?	30	65
6.0– 7.5	5.5	43.8	36.7	19.5	21	59	20	?	28	60
8.5–10.0	5.8	40.6	42.2	17.2	9	62	29	+?	40	70
11.0–12.5	3.1	37.5	38.3	24.2	9	57	34	+	30	50
13.5–15.0	3.7	39.5	37.1	23.4	9	59	32	+	40	65
16.0–17.5	4.8	40.2	37.9	21.9	10	59	31	+	35	65
18.5–20.0					9	59	32	+	30	70
25.0–26.5	3.0	40.5	37.0	22.5	9	62	29	+	32	65
30.0–31.5	6.4	49.8	34.8	15.4	9	63	28	?	27	65
35.0–36.5	4.2	37.8	38.5	23.7	9	56	35	+	27	50
40.0–41.5	5.0	44.7	35.0	20.3	7	62	31	?	35	60
45.0–46.5	4.8	34.8	37.9	27.3	6	64	30	?	35	65
50.0–51.5	3.9	36.3	37.9	25.8	5	65	30	?	40	65
Boring No. 46										
1.0– 2.5					20	65	15	?	–	6
3.5– 5.0	4.1	37.0	38.3	24.7	20	65	15	+	30	50
6.0– 7.5	2.5	37.4	38.7	23.9	24	63	13	+	20	30
8.5–10.0	2.2	37.1	39.3	23.6	21	67	12	?	17	28
11.0–12.5					30	61	9	?	–	–
13.5–15.0	3.3	37.0	38.9	24.1	19	67	14	?	20	42
16.0–17.5	4.9	46.6	33.5	19.9	18	61	21	?	30	55
18.5–20.0	4.0	37.5	38.8	23.7	27	59	14	?	22	55
25.0–26.5	3.5	25.1	41.5	33.4						
30.0–31.5	1.8	19.9	49.8	30.3						
35.0–36.5	8.0	46.1	35.2	18.7						
40.0–41.5	1.8	52.3	31.5	16.2						
Boring No. 47										
1.5– 3.0								–	4	55
4.5– 6.0					6	70	24	–	10	115
7.0– 9.0					8	70	22	–	–	22
9.0–10.5					3	75	22	–	20	60
12.0–13.5										
16.0–17.5					7	80	13	–	25	65
19.0–20.5					13	63	24	+	25	40
25.0–26.5	6.3	32.0	38.9	29.1	8	62	30	+	35	50
30.0–31.5	2.1	31.9	38.4	29.7	8	63	29	+	28	40
35.0–36.5	2.8	32.1	38.6	29.3	7	63	30	+	26	40
40.0–41.5					7	63	30	+	32	45
45.0–46.5					7	66	27	+	25	35
50.0–51.5	5.0	37.1	35.7	27.2	7	61	32	+	40	50

TABLE 2 - Continued

Depth (feet)	Grain Size (percent) +2mm Gravel	-2mm Sand	-2mm Silt	-2mm Clay	Clay Minerals (percent) Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Carbonates (counts per second) Calcite	Dolomite
Boring No. 51										
0.0- 5.0					81	10	9	+	-	-
5.0-10.0	5.7	45.0	34.1	20.9	33	40	27	-	25	110
10.0-15.0	5.6	61.5	24.0	14.5	20	55	25	-	32	145
15.0-20.0	4.6	41.2	33.9	24.9	6	63	31	-	40	100
20.0-25.0					6	59	35	-	28	115
25.0-30.0	3.1	36.5	36.2	27.3	6	60	34	-	31	100
30.0-35.0					7	60	33	-	43	120
35.0-40.0	3.2	35.8	36.8	27.4	7	57	36	-	28	90
40.0-45.0					7	61	31	-	42	115
45.0-50.0	6.9	35.7	38.4	25.9	5	63	32	-	35	110
50.0-55.0	2.4	56.7	36.7	6.6					25	320
55.0-60.0	-	52.0	42.4	5.6	4	64	32	-	43	140
60.0-65.0	1.5	58.9	25.4	15.7	73	10	17	+	12	30
65.0-70.0	1.1	64.2	26.6	9.2	37	37	25	-	16	120
70.0-75.0	5.1	57.5	27.6	14.9	12	55	33	?	33	125
Boring No. 57										
15.0-20.0	1.1	50.3	30.6	19.1						
25.0-30.0	3.8	38.1	34.7	27.2						
35.0-40.0	3.4	38.3	35.2	26.5						
45.0-50.0	7.0	38.6	35.1	26.3						
55.0-60.0	30.8	46.9	30.3	22.8						
65.0-70.0	7.5	42.3	33.5	24.2						
75.0-80.0	4.7	40.8	34.3	24.9						
100.0-105.0	6.4	49.7	30.2	20.1						
135.0-140.0	-	0.5	33.8	65.7						
145.0-150.0	-	39.7	51.0	9.3						
155.0-160.0	1.6	34.0	33.7	32.3						
165.0-170.0	41.9	83.1	10.6	6.3						
185.0-190.0	11.1	30.8	35.6	33.6						
195.0-200.0	16.4	35.2	29.9	34.9						
205.0-210.0	41.1	89.5	4.9	5.6						
260.0-265.0	4.7	58.4	22.8	18.8						
270.0-275.0	4.5	83.9	10.7	5.4						
305.0-310.0	10.1	55.9	25.0	19.1						
315.0-320.0	12.5	51.6	27.3	21.1						
320.0-325.0	1.6	87.7	7.2	5.1						
Boring No. 61										
25.0-30.0	6.6	40.5	33.6	25.9						
45.0-50.0	3.3	36.8	36.0	27.2						
75.0-80.0	2.1	34.6	35.1	30.2						
100.0-105.0	3.4	41.9	33.4	24.7						
120.0-125.0	5.1	46.4	34.7	18.9						
140.0-145.0	4.2	60.6	24.0	15.4						
165.0-170.0	1.3	53.9	33.7	12.4						

TABLE 2 - Continued

Depth (feet)	Grain Size (percent) +2mm Gravel	-2mm Sand	Silt	Clay	Mineral X-ray Analyses (-2 micron fraction) Clay Minerals (percent) Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Carbonates (counts per second) Calcite	Dolomite
Boring No. 61 cont.										
185.0-190.0	-	8.0	53.3	38.7						
205.0-210.0	7.6	61.3	23.8	14.9						
240.0-245.0	1.5	44.2	31.6	24.2						
260.0-265.0	7.8	41.9	33.6	24.4						
275.0-280.0	-	70.7	19.2	10.0						
295.0-300.0	1.8	9.1	65.6	25.3						
315.0-320.0	9.8	14.2	65.9	19.9						
330.0-335.0	2.0	40.7	36.4	22.9						
345.0-350.0	-	48.2	35.0	16.8						
Boring No. 62										
45.0-50.0					3	66	31	-	28	90
110.0-115.0					4	66	30	-	30	100
115.0-120.0					6	60	34	-	30	105
140.0-145.0					10	60	30	-	37	95
175.0-180.0					-	71	29	-	33	130
185.0-190.0					-	61	39	-	26	150
230.0-235.0					4	68	28	-	28	90
235.0-240.0					3	70	27	-	33	105
245.0-250.0					-	68	32	-	30	65
250.0-255.0					-	70	30	-	28	46
340.0-345.0					36	41	23	+	21	55
345.0-350.0					37	33	30	+	14	52
350.0-355.0					35	38	27	+	25	60
355.0-360.0					40	34	26	+	23	60
Boring No. 68										
5.0-10.0					9	74	17	-	40	60
10.0-15.0					12	72	16	-	32	60
15.0-20.0	1.5	35.4	36.0	28.6	11	67	22	-	40	55
20.0-25.0					8	67	25	-	28	36
25.0-30.0	4.1	34.4	35.7	29.8						
35.0-40.0	6.1	37.5	35.1	27.4						
45.0-50.0					6	65	29	-	39	50
50.0-55.0					7	66	27	-	35	50
65.0-70.0	32.1	53.4	29.8	16.7						
70.0-75.0					5	70	25	-	34	42
75.0-80.0	13.8	45.2	38.5	16.3	7	66	27	-	36	40
80.0-85.0					9	66	25	-	30	40
90.0-95.0					5	66	29	-	40	90
95.0-100.0					7	66	27	-	32	55
100.0-105.0					19	64	17	-	33	48
105.0-110.0	7.7	42.9	30.9	26.2	14	70	16	-	45	50
110.0-115.0	4.6	49.0	32.4	18.5	18	61	21	-	48	55
115.0-120.0	19.8	66.3	22.5	11.1	14	66	20	-	42	60
120.0-125.0					11	64	25	-	45	65

TABLE 2 – Continued

Depth (feet)	Grain Size (percent)				Mineral X-ray Analyses (–2 micron fraction)					
					Clay Minerals (percent)				Carbonates (counts per second)	
	+2mm	–2mm								
	Gravel	Sand	Silt	Clay	Montmor-illonite	Illite	Chlorite & Kaolinite	Kaolinite	Calcite	Dolomite
Boring No. 68 cont.										
125.0–130.0					14	59	27	–	38	62
130.0–135.0	30.1	74.8	16.0	9.2	8	67	25	–	25	55
140.0–145.0					6	68	26	–	33	65
145.0–150.0	8.4	54.2	29.4	16.5	18	61	21	–	27	42
150.0–155.0	4.6	60.0	25.9	14.0	16	63	21	–	33	42
155.0–160.0					36	46	18	+	22	27
160.0–165.0					47	36	17	+	13	21
165.0–170.0					44	40	16	+	9	12
170.0–175.0	1.1	55.1	30.9	14.0	45	37	18	+	10	10
175.0–180.0					42	40	18	+	8	12
180.0–185.0	9.4	9.4	47.7	42.8	35	44	21	+	18	22
185.0–190.0					46	31	23	+	?	7
190.0–195.0					31	38	31	+	–	8
195.0–200.0	10.6	40.9	32.4	26.7	13	72	15	+	9	–
200.0–205.0	18.5	48.2	28.9	22.9						
205.0–210.0					13	72	15	+	12	8
Boring No. 70										
5.0–10.0	2.8	40.8	39.1	20.1						
25.0–30.0	4.4	37.8	42.9	19.3						
65.0–70.0	11.9	40.4	35.8	23.8						
105.0–110.0	5.2	37.5	33.4	29.1						
125.0–130.0	15.9	50.5	29.3	20.2						
145.0–150.0	16.4	40.5	38.4	21.1						
185.0–190.0	9.6	35.7	41.9	22.4						
205.0–210.0	11.6	89.0	6.3	4.7						
230.0–235.0	11.6	84.6	9.5	5.9						
245.0–250.0	–	26.3	37.5	36.2						
265.0–270.0	1.6	44.0	32.2	23.8						
285.0–290.0	20.8	50.8	30.2	19.0						
300.0–310.0	13.3	51.3	27.8	20.9						
345.0–350.0	–	75.1	13.5	11.4						
375.0–380.0	–	11.5	54.9	33.6	27	49	24	+	–	12
380.0–385.0	2.2	14.9	53.5	31.6	29	48	23	+	–	5
385.0–390.0	2.1	22.3	48.9	28.8	39	40	21	+	–	–
390.0–395.0	–	18.6	51.9	29.5	30	47	23	+	–	–

TABLE 3 - AVERAGE CLAY MINERAL COMPOSITION -2 MICRON FRACTION OF UNALTERED TILLS FROM SELECTED WELLS AND BORINGS

Unit	Well	Montmorillonite† %	Illite %	Chlorite and Kaolinite %	Kaolinite
E	43	8	63	29	present
	44	8	62	30	?
	45	9	59	32	present
	47	7	63	30	present
	51	6	61	33	
	56	6	62	32	
	62	3	66	31	
	68	6	66	28	
D	24	8	62	30	
	27	8	64	28	
	30	9	62	29	
	34	8	63	29	
	62	5	63	32	
	68	7	67	26	
C-3	11	7	67	26	
	24	14	61	25	
	29	4	65	31	
	31	8	66	26	
	36	6	64	30	
	68	11	64	25	
C-2	11*	3	74	23	
	19	3	70	27	
	29	8	63	29	
	36	4	70	26	
	40	10	62	28	
	68*	17	62	21	
C-1	11*	8	72	20	
	16	–	71	29	
	32*	12	67	21	
	37*	9	73	18	
	40	1	70	29	?
B	62	37	36	27	present
	68	43	40	17	present

* May be slightly altered.
† Units C through E contain mainly expandable vermiculite and vermiculite–chlorite.

TABLE 4 – DESCRIPTIONS OF SAMPLES FROM SELECTED BORINGS AND WELLS

Locations are shown in figure 4 and described in table 1.

Intervals sampled (IS) are indicated in feet below top.

TOLL HIGHWAY BORING 2	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Peoria Loess		
Silt, yellowish brown (10YR 4/4) mottled with gray, micaceous, noncalcareous (IS 1½–3)	4	4
Silt, yellowish brown (10YR 5/6), slightly calcareous, micaceous (IS 4.5–6)	3	7
Silt, yellowish brown (10YR 5/4), very sandy, slightly calcareous; little grayish brown (10YR 5/2), noncalcareous at top (IS 7½–9)	3	10
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, yellowish brown (10YR 5/4), calcareous, sandy (IS 10½–12)	3	13
Interstadial silt		
Silt, slightly clayey, dark yellowish brown (10YR 4/4), micaceous, noncalcareous; contains carbonized leaf imprints and organic streaks (IS 13½–15)	3	16
Sub-unit C-2		
Till, dark yellowish brown (10YR 4/4), slightly calcareous, very sandy; some grayish brown (10YR 4/4); contains little black shale with tasmanites (IS 16½–18)	3	19
Till, grayish brown (10YR 4/2), slightly calcareous, very sandy; little yellowish brown (10YR 4/4); contains little black shale with tasmanites (IS 19½–21)	4	23
Gravel and sand, angular; contains mostly dolomite, some igneous and metamorphic grains (IS 25–26½)	4	27TD

BORING 5

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Peoria Loess		
Silt, black (10YR 2/1), slightly dolomitic, organic (surface soil) (IS 1½–3)	4	4
Silt, yellowish brown to grayish brown (10YR 4/3), noncalcareous (IS 4½–6)	3	7
Silt, yellowish brown (10YR 5/8) to brown (10YR 5/3), dolomitic (IS 7½–9)	3	10
Silt, light brownish gray (10YR 6/2) streaked with yellowish brown, massive, dolomitic; grades downward to bedded, noncalcareous silt (IS 10½–11½)	1½	11½
Farmdalian Substage		
Farmdale Silt		
Silt, very dark brown (10YR 3/3), organic, faintly bedded, noncalcareous (IS 11½–12)	1½	13
Silt, grayish brown (10YR 5/2–4/2), faintly bedded with orgainc? streaks, contorted, noncalcareous (IS 13½–15)	3	16
Silt, dark gray to dark grayish brown (10YR 4/1–4/2), slightly sandy and gravelly, bedded, noncalcareous; little dark yellowish brown (10YR 4/4), noncalcareous silt along joint (IS 16½–18)	3	19
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till?, yellowish brown to brown (7.5YR 5/6), very silty, sandy, dolomitic (IS 19½–21)	4	23
Till, brown to dark brown (7.5YR 5/4–4/2), sandy; contains calcite and dolomite (IS 25–26½; 30–31½)	9	32 TD

BORING 11

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Peoria Loess		
Silt, slightly sandy, brown (10YR 4/3), micaceous, noncalcareous (IS 1½–3)	4	4
Altonian Substage		
Unit C		
Sub-unit C-3 (Winnebago drift)		
Till, yellowish brown (10YR 5/4), slightly pebbly, sandy, dolomitic (IS 4½–6)	3	7
Till, yellowish brown to brown (10YR 5/4–7.5YR 5/4), pebbly, sandy; contains calcite and dolomite (IS 10½–12; 13½–15; 16½–18; 19½–21; 25–26½)	21	28
Till, violet-gray (7.5YR 4/2), pebbly, sandy; contains calcite and dolomite (IS 30–31½; 35–36½)	10	38
Sub-unit C-2		
Till, brownish gray to gray (10YR 4/2–4/1), slightly pebbly; contains calcite, dolomite, and black shale (IS 40–41½; 45–46½; 49–50½)	17	55
Gravel, granular, sandy, silty, calcareous; contains some black shale (IS 60–61½)	6½	61½
Sub-unit C-1		
Till, dark grayish brown (10YR 4/2), slightly pebbly, silty; contains calcite and dolomite (IS 61½–62; 62½–64; 70–71½)	10	71½ TD

BORING 28

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit D		
Sub-unit D-3		
Sand, dark brown (7.5YR 4/4), medium to very fine, very silty, noncalcareous (IS 1½–3; 4½–6)	7	7
Sand, yellowish brown (10YR 5/6), very fine to very coarse, silty, dolomitic; contains little gravel (IS 7½–9)	3	10
Sand (till?), yellowish brown (10YR 5/4), very fine to coarse, very silty, slightly gravelly; contains calcite and dolomite (IS 10½–12)	3	13
Till, brown to pinkish brown (7.5YR 4/4), sandy; contains calcite and dolomite (IS 13½–15)	3	16

	Thickness (ft)	Depth of base (ft)
Sub-unit D-2 (?)		
Sand, dark yellowish brown (10YR 3/4–4/4), very silty, dolomitic; contains numerous wood fragments; little black silt at top (IS 16½–18; 19½–21)	5	21TD

BORING 29

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Richland Loess		
Silt, very dark yellowish brown (10YR 3/4), micaceous, noncalcareous (IS 1½–3)	4	4
Unit D		
Sub-unit D-3		
Till, light yellowish to light greenish brown (10YR 5/8 to 2.5YR 6/2), dolomitic, slightly sandy (IS 4½–6)	3	7
Till, yellowish brown (10YR 5/4); contains calcite and dolomite (IS 7½–9; 10½–12)	6	13
Sub-unit D-2		
Till, dark yellowish brown (10YR 4/4), very sandy, slightly pebbly; contains calcite and dolomite (13½–15)	3	16
Till, yellowish brown (7.5YR 4/4–5/4); contains calcite and dolomite (IS 16½–18; 19½–21)	7	23
Sub-unit D-1		
Sand, slightly silty, medium to coarse, brown (10YR 4/3), calcareous (IS 24–25)	2	25
Till, dark violet brown (7.5YR 4/2); contains calcite and dolomite (IS 25–25½; 30–31½; 35–36½)	13	38
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, dark yellowish brown (10YR 4/4), sandy; contains calcite and dolomite (IS 40–41½)	5	43
Till, dark grayish brown (10YR 4/2), very sandy; contains calcite and dolomite (IS 45–46½)	5	48
Till, brown (10YR 4/3–5/3), sandy; contains calcite and dolomite (IS 50–51½; 55–55½)	10	58
Sub-unit C-2		
Till, brown to grayish brown (10YR 5/3–4/2), gravelly at base; contains calcite and dolomite (IS 60–61½; 64–65½)	8	66TD

BORING 40

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Richland Loess		
Silt, dark yellowish brown to olive brown (10YR 4/4), organic, noncalcareous (IS 1–2½)	3	3
Unit D		
Till?, very dark yellowish brown to very dark brown (10YR 3/4–2/2), organic, sandy, silty, dolomitic; contains calcite in lower sample (IS 3½–5; 6–7½)	5	8
Farmdalian Substage		
Farmdale Silt		
Silt, very dark gray (10YR 3/1), highly organic, slightly pebbly, slightly dolomitic (8½–10)	2½	10½
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, dark yellowish brown (10YR 4/4), dolomitic, sandy, compact (IS 11–12½)	2½	13
Till, dark brown (10YR 4/3), compact, sandy; contains calcite and dolomite (IS 13½–15)	2½	15½
Interstadial silt		
Silt, very dark gray (10YR 3/1), highly organic, pebbly, noncalcareous, micaceous (IS 16–17½)	2½	18
Sub-unit C-2		
Till, brown (10YR 4/3–5/3), sandy; contains calcite and dolomite; becomes grayish brown (10YR 4/2) at base (IS 18½–20; 25–26½; 30–31½; 35–36½)	20	38
Sub-unit C-1		
Till, dark gray (10YR 4/1); contains calcite and dolomite (IS 40–41½)	5	43
Sand, grayish brown (10YR 4/2), silty, gravelly; contains calcite and dolomite, some till as above, some silt at top (IS 45–46½)	5	48
Till, dark gray (10YR 4/1), sandy and yellowish brown at base; contains calcite and dolomite (IS 50–51½; 55–56½)	9	57TD

BORING 41

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit D		
Till?, yellowish brown (10YR 4/4–5/4), sandy, gravelly, cobbly, calcareous (IS 1–2½; 3½–5)	5½	5½
Till?, brown (10YR 5/3), sandy, gravelly, cobbly, calcareous, very sandy at base (IS 6½–7½; 8½–10; 11–12½; 13½–15)	10	15½
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Sand, brown (10YR 4/3), very fine to fine, calcareous; contains little bedded silt and clay (IS 16–17½; 18½–20)	7½	23
Till?, brown (7.5YR 5/4), very silty, sandy, calcareous; contains few wood fragments (IS 25–26½)	5	28
Interstadial deposits		
Peat, mainly twigs and woody mulch with considerable plant tissue, very dark brown; interbedded sand in middle samples; date on lower sample is >38,000 yrs. B.P. (W-1144) (IS 30–31½; 32–34; 35–36½)	8½	36½
Sub-unit C-2		
Silt and clay (accretion gley), slightly sandy and pebbly, very dark grayish brown to very dark gray (10YR 3/2–4/1), slightly calcareous at base (IS 36.5–37.3; 37.3–38.1)	1.6	38.1
Sand, light yellowish brown to light olive brown (2.5YR 6/2–5/2), very fine to medium, calcareous; some coarse, very silty; may be till (IS 38.1–39.5)	1.4	39½TD

WELL 51

	Thickness (ft)	Depth of base (ft))
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Richland Loess		
Silt, gray (10YR 4/1-4/2), leached; little brownish yellow (10YR 5/2)	5	5
Unit E		
Till, dark brown to brown (5YR 4/2-7.5YR 4/2); contains calcite and dolomite	10	15
Till, pinkish brown (5YR 4/2); contains calcite and dolomite	35	50
Unit D		
Sand, very silty, very fine to fine, little medium to coarse, grayish brown (7.5YR 5/2-5/4); contains calcite, dolomite, and a trace of shell fragments at top	10	60
Farmdalian Substage		
Sand, extremely silty, slightly clayey, very fine to coarse, little coarse, dark grayish brown (2.5YR 4/2); contains calcite and dolomite; some greenish brown (10YR 3/3)	5	65
Altonian Substage		
Unit C (Winnebago drift)		
Sand (till?), extremely silty, very fine to medium, little coarse to very coarse, dark grayish brown (10YR 4/3); contains calcite and dolomite	5	70
Till, sandy, silty, dark grayish brown (7.5YR 4/4 to 10YR 5/3); contains calcite and dolomite	7	77
Ordovician System - Maquoketa Group		

WELL 57

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit E		
Till, gravelly to sandy, slightly silty, yellowish brown (7.5YR 4/4), calcareous, oxidized	10	10
Gravel, very sandy, slightly silty, multicolored	5	15
Till, gravelly, silty to sandy, brown (7.5YR 4/4), calcareous	5	20
No sample	5	25
Till, compact, silty to clayey, slightly sandy, slightly gravelly, grayish brown (7.5YR 4/2), calcareous	30	55
Unit D		
Till, silty to clayey, slightly sandy, slightly gravelly, gravelly to sandy at base, grayish brown to brown (7.5YR 4/2-5/4), calcareous	55	110
Sand (till?), slightly gravelly, slightly silty, multicolored, fine to medium	10	120
Silt, clayey, brown (7.5YR 4/2), calcareous, laminated; contains interbedded till, very silty to sandy, very gravelly, brown to yellowish brown (10YR 5/3-4/3-4/4), calcareous; also contains interbedded gravel, silty, multicolored, medium to coarse	90	210
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, gravelly, sandy to very sandy, silty, brown (7.5YR 4/2-10YR 6/3), calcareous	25	235
Sand, silty, white, fine to medium, little coarse	24	259
Sub-unit C-2		
Till, very sandy to silty, little gravel, yellowish brown (10YR 6/4-5/3), calcareous	26	285
Sand and gravel, multicolored, fine to coarse sand	10	295
Sub-unit C-1 (?)		
Till, very gravelly, sandy to silty, brown to dark brown (10YR 5/4-7.5YR 5/4 to 10YR 3/3), calcareous	30	325
Illinoian (?) Stage		
Unit B(?)		
Sand, slightly gravelly, slightly silty, white, fine to coarse	65	390
Ordovician System-Galena-Platteville Dolomite		

WELL 61

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit E		
Soil, black to brown (10YR 2/1), leached	5	5
Till, sandy to gravelly, slightly clayey, pinkish brown (7.5YR 4/2), calcareous; silty to very silty at top (no samples 20-25, 40-45, 80-85)	80	85
Unit D		
Till, silty to clayey, slightly gravelly to sandy, pinkish brown (7.5YR 4/2), calcareous	50	135
Altonian Substage		
Unit C		
Sub-unit C-3		
Till, very sandy to silty, dark brown (10YR 4/3), calcareous; grayish brown (10YR 5/2) at base	40	175
Silt (till?), clayey, grayish brown (10YR 5/2), calcareous	25	200
Sub-unit C-2		
Till, very sandy to silty, greenish brown to yellowish brown (10YR 4/4-5/3), calcareous	40	240
Till, compact, silty to clayey, slightly sandy, dark brown (10YR 4/3), calcareous; grayish brown (10YR 4/2), at top	35	275
Till, very sandy to very gravelly, silty at top, greenish brown to brown (10YR 5/3-4/4), calcareous	20	295
Silt (till?), compact, very clayey, slightly sandy, greenish brown (10YR 5/3), calcareous	25	320
Sand, silty, slightly gravelly, multicolored, coarse to medium	5	325
Sub-unit C-1 (?)		
Till, silty, brown to light brown (10YR 4/3-5/4), calcareous; sandy to very sandy at base	25	350

	Thickness (ft)	Depth of base (ft)
Illinoian Stage		
Unit B		
Till, very silty to silty, slightly clayey, greenish brown to brown (10YR 4/3–4/4–5/4), calcareous	40	390
Pre-Illinoian Stage		
Unit A		
Sand, slightly silty to silty, slightly gravelly, yellowish buff to yellowish brown, medium to coarse, little fine	29	419
Ordovician System—Glenwood-St. Peter Sandstone		

WELL 68

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit E		
No sample	5	5
Till, gravelly, silty, pinkish brown (5YR 5/6); contains calcite, dolomite, and spores	10	15
Till, silty, slightly sandy, pinkish brown (5YR 4/3–4/4); contains calcite, dolomite, and spores	5	20
Till, silty, slightly sandy, brownish gray (5YR 4/2–4/3); contains calcite and dolomite	30	50
Unit D		
Till, sandy, slightly gravelly, silty to clayey, reddish brown (5YR 4/2–4/3); contains calcite and dolomite	30	80
Till, very sandy to gravelly, silty, brown (10YR 4/3), calcareous	10	90
Till?, very sandy to very gravelly, silty, brown (10YR 5/3); contains calcite and dolomite	10	100
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, sandy to silty, green (10YR 6/4); contains calcite and dolomite	5	105
Till, silty, slightly sandy to slightly gravelly, brown (7.5YR 5/4); contains calcite and dolomite	15	120
Till, gravelly to sandy, silty, reddish brown (5YR 4/2); contains calcite and dolomite	10	130
Till, extremely sandy to gravelly, silty, grayish brown (10YR 5/3); contains calcite and dolomite	15	145
Sub-unit C-2		
Till, very sandy to gravelly, brown (10YR 4/4); contains calcite and dolomite	10	155
Illinoian Stage		
Unit B		
Till, sandy, slightly gravelly, yellowish brown (10YR 4/4); contains calcite and dolomite	10	165
Till, dark grayish brown (10YR 4/2), sandy, slightly gravelly; contains calcite and dolomite	10	175
Silt, clayey, slightly gravelly and sandy, dark grayish brown to dark brown (10YR 3/4–4/4), faintly laminated, dolomitic	15	190
Till, dark grayish brown (10YR 4/4), dolomitic, very gravelly, slightly sandy	5	195
Till, grayish brown (2.5YR 5/4); contains some calcite, little or no dolomite	15	210
Ordovician System—Galena-Platteville Dolomite		

WELL 70

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit F		
Till, sandy to silty, slightly gravelly, reddish brown (5YR 4/3), calcareous	15	15
Till, silty to clayey, compact at base, slightly sandy to slightly gravelly, brown (10YR 4/2–4/3), calcareous	28	43
Gravel, multicolored; some till, silty to sandy, dark brown (10YR 3/4), calcareous	20	63
Unit E		
Till, silty to sandy, brown (10YR 4/3), calcareous; slightly gravelly to very gravelly at base	27	90
Till, silty, slightly clayey, slightly sandy, reddish brown (7.5YR 4/2), calcareous; slightly gravelly to gravelly at base	65	155
No sample	5	160
Unit D		
Till, silty to clayey, slightly gravelly, slightly sandy, greenish brown (10YR 4/4), calcareous	5	165
No sample	5	170
Till, silty to clayey, grayish brown (10YR 4/2), calcareous; sandy to gravelly at base	30	200
Till, extremely sandy, slightly gravelly, yellowish brown (10YR 5/3), calcareous	10	210
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, extremely sandy, slightly gravelly, yellowish brown (2.5YR 5/4)	10	220
No sample	5	225
Till, yellowish brown to brown (10YR 4/4–5/4), calcareous; very sandy to slightly sandy at base, gravelly at top, silty to clayey at base	10	235
Sand, slightly gravelly, multicolored (pinkish hue), fine to coarse	10	245
Silt, clayey, slightly sandy, dark brown (10YR 3/3), calcareous	20	265
Sub-unit C-3		
Till, silty to sandy, slightly clayey, dark brown to grayish brown (10YR 3/3–4/2), calcareous	60	325
Illinoian Stage		
Unit B		
Sand, multicolored, medium to coarse grained, some fine; lower 20 feet slightly gravelly	50	375
Silt, clayey, slightly sandy, light brown and dark brown (10YR 2/1–3/2), calcareous, laminated; contains wood fragments	20	395
Pre-Illinoian Stage		
Unit A		
Sand, multicolored (pinkish tinge), medium to coarse, some fine	17	412
Cambrian System—Trempealeau Dolomite		

WELL 77

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Peoria Loess		
Silt, slightly sandy, brown (7.5YR 4/4), slightly micaceous, noncalcareous	10	10
Altonian Substage		
Unit C (Winnebago drift)		
Sub-unit C-3		
Till, very sandy, slightly gravelly, silty, light brown (7.5YR 5/4-5/6), calcareous	30	40
Sub-unit C-2		
Sand, very silty, slightly gravelly, yellow (10YR 6/4), fine to coarse grained, calcareous	20	60
Silt, sandy, brownish gray (10YR 4/3); some clay, gray (10YR 5/1), calcareous	5	65
Sand, slightly gravelly, slightly silty, fine to coarse, gray, calcareous	15	80
Till, very gravelly, sandy, gray (10YR 5/1), calcareous	30	110
Ordovician System—Galena-Platteville Dolomite		

WELL 85

	Thickness (ft)	Depth of base (ft)
Pleistocene Series		
Wisconsinan Stage		
Woodfordian Substage		
Unit F		
Till, gravelly, sandy, reddish brown (5YR 4/3), calcareous	25	25
Units E, D?		
Till, slightly gravelly, reddish brown (5YR 4/2), calcareous	180	205
Unit C (Winnebago drift)		
Silt, organic, slightly sandy, black (10YR 2/1), noncalcareous	5	210
Sand, clayey, fine to coarse, organic, dark greenish brown (10YR 4/2), noncalcareous	5	215
Sand, dark yellowish brown, fine to medium, slightly gravelly, calcareous	35	250
Till, silty, gravelly, brown (10YR 5/3), calcareous	15	265
Silurian System-dolomite		

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