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ILLINOIS STATE GEOLOGICAL SURVEY

NATURAL RESOURCES BUILDING
URBANA, ILLINOIS 61803
JOHN C. FRYE, CHIEF

April 26, 1966

Mr. Gene H. Graves, Director
Department of Business and
Economic Development
Springfield, Illinois

Dear Gene:

Enclosed herewith are two copies of a report entitled, "Effects of Waste Water Disposal and Ground-Water Pumping on Foundation Stability and Subsurface Water Drainage Conditions at the Western, Illinois Site," prepared in response to questions raised during a visit by representatives of the U. S. Atomic Energy Commission to the Western site on April 8, 1966.

It is my understanding that this report is to be transmitted to the A.E.C. through your office. One copy of the report is for your files. Additional copies can be provided if there is a need.

Sincerely,

James E. Hackett
Geologist-in-charge
Northeast Illinois Office
Naperville, Illinois

Enclosures

Do as a MS.

EFFECTS OF WASTE WATER DISPOSAL AND GROUND-WATER PUMPING ON FOUNDATION STABILITY AND SUBSURFACE WATER DRAINAGE CONDITIONS AT THE WESTON, ILLINOIS SITE

By

WCS

James E. Hackett, Geologist
Section of Ground-Water Geology and Geophysical Exploration

This report provides information on: (1) the effects of waste water disposal and ground-water pumping on foundation conditions at the Weston, Illinois site during construction and future operation of the proposed 200 BEV Accelerator; (2) the nature of drainage problems that can be anticipated during construction of this facility, to depths of 30 feet. These questions were submitted by representatives of the United States Atomic Energy Commission in the course of their visit to the Chicago area on April 8, 1966.

For detailed description of geologic conditions and engineering characteristics of materials at the Weston site reference should be made to pages 32 through 38 of the report prepared by the Illinois State Geological Survey and submitted to the United States Atomic Energy Commission in November, 1965, entitled "Supplemental Report on Geologic Conditions at Proposed Sites."

(1) Effects of waste water disposal and ground-water pumping

The disposal of liquid waste products through wells (deep well disposal) is not practical in the Weston area nor is such procedure likely to be allowed in this part of northern Illinois. All of the permeable units underlying the Weston site contain potable water and are utilized as a source of water by communities and industries throughout the region. The possibility for detrimental earth shock effects on an accelerator installation as a consequence of deep waste water disposal can be dismissed owing to existing controls over use of such methods as protection against pollution of potable water sources.

The question of extent of subsidence as a consequence of ground-water pumpage was discussed by the writer with Dr. Don U. Deere, Professor of Geology and of Civil Engineering, University of Illinois. The following is what we believe to be a pertinent analysis of this question in light of available geologic, hydrologic, and engineering property data.

Aquifers occur at several levels beneath the Weston site. The major aquifers are: The shallow dolomite aquifer, the base of which occurs at a depth of about 275 feet (assuming a surface elevation of 745 M.S.L.); the St. Peter sandstone, the top of which is at a depth of about 685 feet, the Ironton-Galesville at a depth of about 1220 feet, and the Mt. Simon sandstone at a depth of about 1845 feet.

The shallow dolomite aquifer is separated from the deeper aquifer systems by the Maquoketa shale and dolomite, the base of which is at a depth of about 375 feet. According to water level data collected by the Illinois State Water Survey, the piezometric surface of the Cambrian-Ordovician Aquifer, which includes the St. Peter and Ironton-Galesville Sandstone is at or below the base of the Maquoketa Group. Therefore, further water level decline in this system will not result in an increase in the head differential through the confining layer.

Because the major aquifer units occur within a sequence of indurated rock of Paleozoic age, compaction of these sediments as a result of water pressure level lowering will be negligible and settlement effects on foundations will be inconsequential.

The shallow dolomite aquifer is overlain by 70 to 125 feet of glacial deposits. The glacial deposits consists mainly of pre-loaded glacial till of low permeability. Because of the tight character of these materials, saturation level occurs at relatively shallow depth (± 10 feet) and movement into the underlying dolomite aquifer is impeded. As a result, lowering of water level in the dolomite aquifer is not generally accompanied by a corresponding lowering of the saturation level in the overlying till.

Potential for compaction of the glacial deposits as a consequence of lowering of water levels by pumpage from the shallow dolomite aquifer can be determined by comparison of the increase in effective pressure that might be developed at the base of drift cover with loading characteristics of the till. Average water level in the dolomite aquifer beneath the Weston site is at present approximately 35 feet below land surface. The thickness of drift cover over the aquifer ranges from about 70 to 125 feet. Assuming a lowering of water level in the dolomite aquifer as a consequence of pumpage to the base of the drift at the deepest known point and assuming no change in saturation level within the drift as a consequence of this water level decline, it can be estimated that the maximum increase in effective pressure on the till at the base of the drift, when fully stabilized, would be (125-35) X 62.4 or 5,616 pounds per square foot. Consolidation tests on glacial tills of this region have shown that they are pre-loaded by dessication effects and glacial ice loads to between 8,000 and 10,000 pounds per square foot. From this analysis it can be concluded that settlements due to compaction of the glacial deposits at the Weston site as a consequence of ground-water pumpage is likely to be small in magnitude (less than one-half inch) and extremely uniformly distributed across the site.

Experiences with the stability of the accelerator installation at Argonne National Laboratories provide some verification for these conclusions. The Argonne installation is less than 20 miles from the Weston site and the geologic conditions relative to foundation conditions at Weston are very similar to those at Argonne. The accelerator assembly at Argonne is supported by a total of 83 caissons to bedrock at a depth of 70 to 85 feet. The cover over bedrock is mainly glacial till similar in composition and characteristics to that which underlies the Weston site. According to records of the Illinois State Water Survey, groundwater withdrawals at the Laboratories have caused a decline in water levels within the dolomite aquifer of about 46 feet. Mr. R. A. Ticha of the Laboratories staff has verified that to date, no settlement problems concerning the accelerator assembly have been indicated in their observations.

(2) Drainage conditions

Drainage of the site during construction to an estimated depth of 30 feet and following completion of the structure is to be considered owing to anticipated saturation levels above this depth throughout the site. Excavation to a 30-foot depth is expected to be mainly within glacial till of low permeability. Fluid discharge from the till into the excavation is likely to be extremely limited and readily handled by pumping from the excavation without need for extensive dewatering preliminary to excavation.

Lenses of more permeable sand and gravel can occur within the glacial till. Where present below the level of saturation these lenses might contribute water into an excavation. The rate and duration of discharge is determined by the thickness, continuity and permeability of individual deposits encountered. The subsurface information available at the Weston site indicates that such materials, if present within the glacial till to anticipated excavation depths, are likely to be thin, discontinuous lenses of limited areal extent and are not likely to present extreme problems of drainage control. More subsurface control is required, however, to assess adequately the occurrence and drainage characteristics of permeable zones within the glacial till to depths of 30 feet.

A thin deposit of fine-textured sand and silt outwash is present at land surface over portions of the Weston site. The depth to the base of these deposits is expected to be generally less than 10 feet. Seepage at the point of contact between the fine-textured outwash and the underlying less permeable glacial till might occur during excavation, particularly in those areas where the contact is beneath the level of saturation. Because of the shallow depth of the outwash deposit, however, any seepage that might be encountered at this position would be readily amenable to control.

In summary, the geologic information available at the Weston site indicates that drainage is not likely to be a problem of such proportions that it cannot be readily handled by pumping from the excavation or gravity drainage through ditches during construction. Final draining of the installation can be accomplished by gravity drains to the West Branch DuPage River to the east or to Fox River west of the site. The discharge point selected would depend upon the minimum elevation established for the base of the excavation.

SUPPLEMENTAL REPORT ON

GEOLOGIC CONDITIONS AT PROPOSED SITES

Prepared by THE ILLINOIS STATE GEOLOGICAL SURVEY for the

ILLINOIS PROPOSAL FOR THE SITE OF
A 200 BEV PARTICLE ACCELERATOR TO
THE U.S. ATOMIC ENERGY COMMISSION

ILLINOIS STATE GEOLOGICAL SURVEY

NATURAL RESOURCES BUILDING
URBANA, ILLINOIS 61803

JOHN C. FRYE, CHIEF

November 24, 1965

Dr. Paul W. McDaniel, Director
Division of Research
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Dr. McDaniel:

In response to the request from the Illinois State Department of Business and Economic Development, we are pleased to present to you a supplementary report describing pertinent data on the geologic conditions at five sites proposed for the 200 BEV Particle Accelerator in the Chicago region of Illinois.

Sincerely yours,

John C. Frye
Chief

Supplemental Report

GEOLOGIC CONDITIONS

prepared by THE ILLINOIS STATE GEOLOGICAL SURVEY for the

ILLINOIS PROPOSAL FOR THE SITE OF

A 200 BEV PARTICLE ACCELERATOR

To The

U.S. ATOMIC ENERGY COMMISSION

This report was prepared by the Illinois State Geological Survey, in consultation with Dr. Don U. Deere, Professor of Civil Engineering and of Geology, University of Illinois, on behalf of the

BOARD OF ECONOMIC DEVELOPMENT,
State of Illinois

CHICAGO AREA RESEARCH AND DEVELOPMENT COUNCIL
Chicago, Illinois

MAYOR'S COMMITTEE FOR THE ECONOMIC AND CULTURAL DEVELOPMENT OF CHICAGO
Chicago, Illinois

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SUPPLEMENTAL REPORT ON GEOLOGIC CONDITIONS AT PROPOSED SITES

FOR THE ILLINOIS PROPOSAL FOR THE SITE OF A 200 BEV PARTICLE ACCELERATOR TO THE U. S. ATOMIC ENERGY COMMISSION

INTRODUCTION

Purpose of Report

The original report of the Illinois proposal for the site of the 200 BEV particle accelerator, prepared by the Illinois Institute of Technology Research Institute and its affiliate, Corplan Associates, provided information on the 12 criteria for site evaluation developed by Lawrence Radiation Laboratory in their design study for the accelerator. This report provides supplemental information on criteria (ii) - geologic conditions at each of the five proposed sites, as defined in the original proposal.

Geologic Factors Considered

The Lawrence Radiation Laboratory design study for the 200 BEV accelerator listed seven geologic factors to be considered in evaluating a site,

a. The ability of site geologic foundations to support required loads

b. The stability of cut-and-fill slopes

c. The ground-water regime

d. The crustal (tectonic) stability of an area encompassing a site

e. The seismicity of an area

f. The availability of shielding fill and concrete aggregate

g. The amenability of site material to excavation

These factors, along with information on relief and drainage conditions, are here described as well as available information permits.

Determination of geologic conditions to provide complete definition of these factors at any specific site would involve investigative programs beyond the scope of this proposal. It is believed, however, that the information presented is sufficient to provide for an assessment of the geologic suitability of each of the proposed sites for location of the 200 BEV accelerator.

Sources of Information

The information on which this supplemental report is based has been compiled from the following sources:

a. Local and regional geologic studies conducted by the Illinois State Geological Survey and made available in its published or unpublished reports

b. Logs of water well drillings in the files of the Illinois State Geological Survey

c. Engineering borings conducted by private contractors and the Illinois State Highway Department for highway and other construction purposes

d. Records of a subsurface drilling and sampling program conducted in the course of an extensive study of the water resources of the Northeastern Illinois Metropolitan Area

e. Consultant's report on seismic activity in Grundy County prepared for Commonwealth Edison Company

f. U. S. Lake Survey data on crustal movements in the Great Lakes region

g. U. S. Coast and Geodetic Survey report on earthquake history of the United States

REGIONAL SETTING

Geology

Glacial Deposits

The five sites proposed in the Chicago region are in an area once covered by glaciers. Several advances and retreats of glacial ice are recorded in the sedimentary deposits and landforms of the area. The surficial features of northeastern Illinois are largely a consequence of glacial activity during the Wisconsinan Stage of glaciation. The advances and recessions of the Wisconsinan glacier resulted in the formation of a

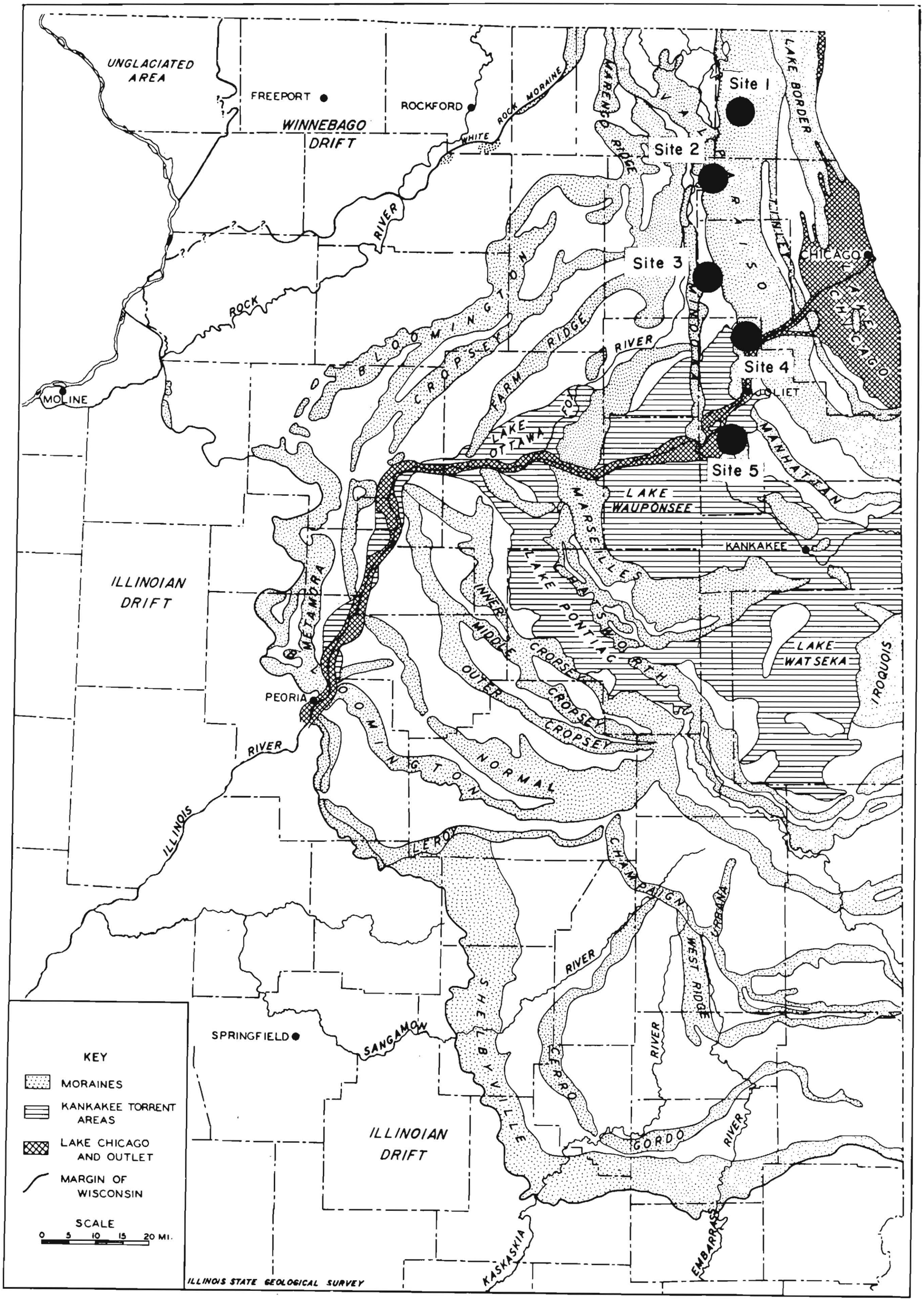


Fig. 1 - Glacial map of northeastern Illinois showing proposed sites.

series of linear, subparallel end moraines and intervening ground moraines (fig. 1). Four of the sites are located on or adjacent to a major morainal element called the Valparaiso Moraine. The fifth site is in part on an end moraine and in part on low-lying terraces made by glacial meltwater.

The most common glacial material in the morainal areas of northeastern Illinois is glacial till, an unsorted deposit released by the glacial ice as it slowly melted. Till consists mainly of clay and silt, with sand, pebbles, and boulders in varying amounts. Commonly present with the till are water-laid deposits of sand and gravel produced as outwash by glacial meltwater. Also present are wind-laid silts (loess), bedded silts and clays deposited in glacial and post-glacial lakes, and deposits of peat and muck that were formed in enclosed, poorly drained depressions. The glacial deposits are unconsolidated and lie on older sedimentary rock.

The maximum thickness of the glacial deposits is about 500 feet in northeastern Illinois. Because of the irregular glacial topography and the uneven surface of the underlying bedrock, the thickness of the unconsolidated glacial deposits differs markedly from place to place within the area.

Bedrock

The sedimentary rock directly beneath the glacial deposits ranges from Pennsylvanian to Ordovician in age (fig. 2). These Paleozoic sediments consist mainly of indurated dolomite, shale, and sandstone, with lesser amounts of coal and limestone.

The region is characterized by relatively simple structure. The rock units have a gentle regional dip to the east and south of about 10 feet per mile. A series of shallow folds trend east-west and pitch eastward with the regional dip.

Faulting is not common in the region outside the Sandwich Fault Zone and the DesPlaines Complex (fig. 2). Faults in the Sandwich Fault Zone are poorly defined but appear to be a complex set of faults rather than a single line of failure. Tracing faults is difficult in this area because of the persistent cover of glacial deposits. The age of the faulting is not definitely known, but regional evidence suggests it is probably late Paleozoic. Faulting in the DesPlaines Complex is extremely complicated and has no apparent relation to regional structure.

All five of the proposed sites are underlain by rocks of Silurian age that are for the most part relatively pure dolomite with minor amounts of shale in thin beds or lenses. They are water-bearing and produce water from joints and other crevices that appear best developed in the upper part of the rock. Cavern development by solution has been recognized locally in the upper surface of the dolomite, but at most locations the rock has been found to be a sound support for heavy structures.

TABLE 1 - SUMMARY OF CHARACTERISTICS OF PROPOSED SITES

CHARACTERISTICS	SITE 1 - WAUCONDA	SITE 2 - SOUTH BARRINGTON	SITE 3 - WESTON	SITE 4 - ARGONNE	SITE 5 - JOLIET ARSENAL
Approximate area	3500 acres	5000 acres	2200 acres	2800 acres	42000 acres
Surface drainage	No direct drainage; enclosed depressions common	Spring and Poplar Creeks. Some enclosed depressions	Kress Creek and two unnamed tributaries of West Branch DuPage River	Lily Cache Creek and a tributary to it. Three ephemeral ponds in area	Prairie, Jackson, Jordan, and other small creeks tributary to DesPlaines and Kankakee Rivers
Range of elevation (ft)	775-840	795-910	715-770	635-740	510-700
Maximum relief (ft)	65±	115±	55±	105	190
Relief at assumed structure	10	20-40	20	30-50	20-40
Saturation levels	Within 20 feet of land surface	Within 20 feet of land surface in till area; within 30 feet of land surface in gravel area	Within 30 feet of land surface	Within 30 feet of land surface in high areas and 20 feet of land surface in low areas	Within 20 feet of land surface in upland area and 10 feet of land surface in valley area
Thickness of unconsolidated materials (ft)	Range: 156-225 Average: 170 Thins to NE	Range: 160-240 Thickens northward	Range: 70-125	Range: 50-129 Appears to thicken northeastward	Range: 0-80
Nature of unconsolidated materials	Tills, with beds of sand, gravel, and silt. Some peat beds may occur	Sand and gravel; silty clay till over sand and gravel. Tills may contain thin beds or lenses of sand, gravel, or silt	Silty clay till overlying thin sand and gravel	Silty clay till; sand and gravel	Silty clay till overlying thin sand and gravel

TABLE 1 - Continued

CHARACTERISTICS	SITE 1 - WAUCONDA	SITE 2 - SOUTH BARRINGTON	SITE 3 - WESTON	SITE 4 - ARGONNE	SITE 5 - JOLIET ARSENAL
Structure foundation	Friction piles to 100-125 feet or end-bearing piles to rock at an average depth of 170 feet	Friction piles to 100-125 feet	End-bearing piles to bedrock at depth of 70-125 feet	Ring magnet might be supported directly on dense sand and gravel or by end-bearing piles to rock at 40-129 feet	End-bearing piles to rock. Possibility of founding structure directly on rock. Problem of possible faulting
Shielding fill	Trench excavation materials and other nearby deposits of till and gravel may be used	Trench excavation materials and other nearby deposits of till and gravel may be used	Trench excavation materials and other nearby deposits of till and gravel may be used	Trench excavation materials and other nearby deposits of till and gravel may be used	Trench excavation materials and other nearby deposits of till and gravel may be used
Stability of cut-and-fill slopes	Cuts stable in till. Problems may be encountered in saturated silts and sands	Cuts stable in till. Problems may be encountered in saturated silts and sands	Cuts of normal slope would be stable	Cuts of normal slope would be stable	Cuts stable in till. Problems may be encountered in saturated silts and sands
Amenability of site materials to excavation	Amenable to standard earth-moving equipment	Amenable to standard earth-moving equipment	Amenable to standard earth-moving equipment	Amenable to standard earth-moving equipment	Amenable to standard earth-moving equipment. In certain areas blasting of rock would be required
Type and attitude of bedrock	Dolomite (Silurian) flat-lying. Bedrock surface may have some relief	Dolomite (Silurian) flat-lying. Bedrock surface may have some relief	Dolomite (Silurian) flat-lying. Bedrock surface may have some relief	Dolomite (Silurian) flat-lying. Bedrock surface may have some relief	Dolomite (Silurian) flat-lying. Bedrock surface may have some relief. Some shale (Maquoketa and Pennsylvanian) may be present locally

Sources of Concrete Aggregate

Sand and Gravel

The extensive deposits of glacial sand and gravel outwash are widely exploited as a source of concrete aggregate. All five of the proposed sites are adjacent to, or in the immediate vicinity of, commercial gravel pit operations.

Crushed Stone

A number of commercial quarries producing crushed dolomite for concrete aggregate are in operation in the Chicago region. All of the proposed sites can be served from this source, and large quantities of aggregate are available.

Geophysical Considerations

Crustal Stability

U. S. Lake Survey data for the southern Lake Michigan region indicate differential crustal movements are negligible. Differential vertical displacements of about 0.1 ft/100 years have been measured between Milwaukee and Chicago and illustrate the crustal stability of the Chicago region. Earth tide studies have not been reported for the region; however, as the northeastern Illinois region is located on a broad, tectonically stable arch of Paleozoic age with no major active structure, it may be assumed that differential movements due to earth tides would be of relatively small proportions.

Seismicity

Northeastern Illinois is in a seismically stable area (see Appendix A). Except for two earthquakes of intensities 6 and 7, with epicenters 50 to 100 miles southwest and northwest of Chicago in Kendall and Winnebago Counties, no earthquakes have been reported for the region for over 300 years.

SITE DESCRIPTIONS

Summary of Sites

Geologic and engineering characteristics of the five sites are summarized in table 1. The table is followed by descriptions of each of the five sites, for which the geologic and engineering characteristics are discussed in detail.

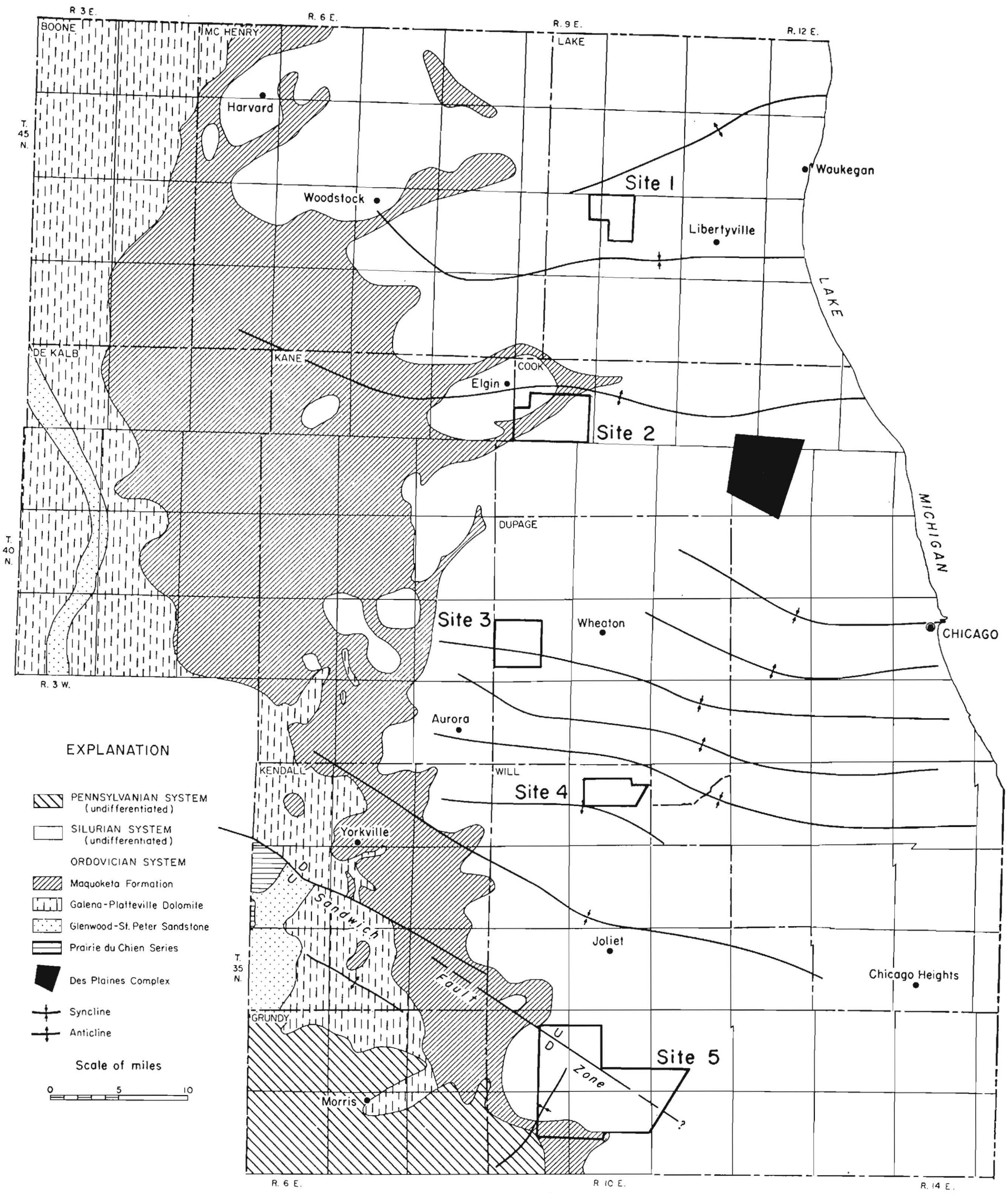


Fig. 2 - Areal geology of the bedrock surface and major structures in the Chicago region.

Site 1 - Wauconda

Location

The Wauconda site comprises approximately 3500 acres in Lake County and is located about 4 miles northeast of Wauconda and Bangs Lake.

Relief and Drainage

The maximum relief of the land surface in the Wauconda site is about 65 feet. In much of the area, however, the topographic relief is only about 25 to 30 feet.

There is no natural, well defined drainage course through the site area, but, as shown in figure 3, a ditch has been constructed through the central part of the region to drain water into Squaw Creek just beyond the east boundary of the site. Many of the swales between the hills are marshy, and there are many closed depressions. In general, adequate surface drainage of the Wauconda site would require ditching and tiling.

Geologic Conditions

Depth to bedrock. - As indicated by the datum points in figure 3 and on the cross sections in figure 4, the depth to bedrock at the Wauconda site ranges from about 156 feet to about 225 feet, depending on the topography of the land surface and that of the bedrock surface.

Nature of unconsolidated deposits. - The cross sections (fig. 4) indicate deposits of silty clay till are interbedded with silt and sand and gravel. The sand and gravel deposits are water bearing. A deposit of wet silt was encountered in one of the borings outside the boundaries of the Wauconda site, and it is possible that lenses of similar material may occur randomly distributed throughout the site.

Deposits of peat are shown on both cross sections in figure 4, and such deposits may occur in the unconsolidated deposits at other places in the area.

The prominent hills in the central part of the site area may be kames built by glacial meltwater and composed largely of sand and gravel.

Characteristics of bedrock. - The uppermost bedrock of the Wauconda site is dolomite of Silurian age. It is generally firm to hard, locally cavernous, more or less cherty in the upper part, may be argillaceous to shaly in the lower part, is more or less jointed or fractured, locally may contain solution channels, and be water bearing. The dolomite may be about 75 to 100 feet thick and is underlain unconformably by the Maquoketa Shale of Ordovician age.

Ground-Water Regime

Ground-water saturation, as estimated from the elevation of streams, ponds, and marshes on the topographic maps, is generally within 20 feet of land surface.

Water levels from logs of two dolomite and two drift water wells on the Wauconda site indicate that the static water level is between 30 and 40 feet below land surface.

Foundation Conditions

Excavation. - For the most part, the unconsolidated drift deposits can be excavated with normal earth-moving equipment. Excavation difficulties might be encountered where water-bearing silt or sand deposits are involved.

Slope stability. - In the clayey glacial till, cuts having normal slopes should be stable. However, the till above water-bearing layers of silt or sand is subject to stability problems because of piping and sloughing of the silt and sand. Filter layers of coarse sand or gravel may be needed to provide stability during construction and to serve as drains on a permanent basis where such water-bearing materials are encountered. Normal fill slopes constructed of compacted glacial till or of suitable granular material should be stable.

Shield material. - Most of the material that would be excavated from the tunnel trench at the Wauconda site would probably be suitable for use as tunnel shield embankment material, except for such materials as silt and peat.

Load bearing and settlement. - Strength data are available from two borings, boring 1-1 about 1½ miles northwest of the Wauconda site, and boring 1-2 about 1½ miles northeast of it. (See boring logs in Appendix B.) Penetration values and unconfined compressive strengths are tabulated on the logs. Different hammer weights and heights of fall were used in the two borings.

At boring 1-1, the penetration values are low, less than 18, to a depth of 37 feet, and the unconfined compressive strengths range from 0.9 to 1.5 tons per square foot. By contrast, in the upper 25 feet of boring 1-2, the penetration values range from 20 to 30 (although by a different hammer and drop). Of more significance, the unconfined compressive strengths are much higher in the second boring, averaging about 4 tons per square foot. In this boring, with only a few exceptions, the penetration values increase from 30 to 60 and the compressive strengths increase from 2 to 9 tons per square foot with depth. At boring 1-1, however, a 3-foot layer of fibrous peat was noted at 44½ feet. The peat is underlain by 47 feet of sand and gravel in an apparent medium-to-dense state (penetration values of 27 to 100). The sand and gravel is underlain in turn by 80 feet of very stiff to hard clay till with unconfined compressive strengths greater than 5 tons per square foot and penetration values ranging from 50 to more than 100.

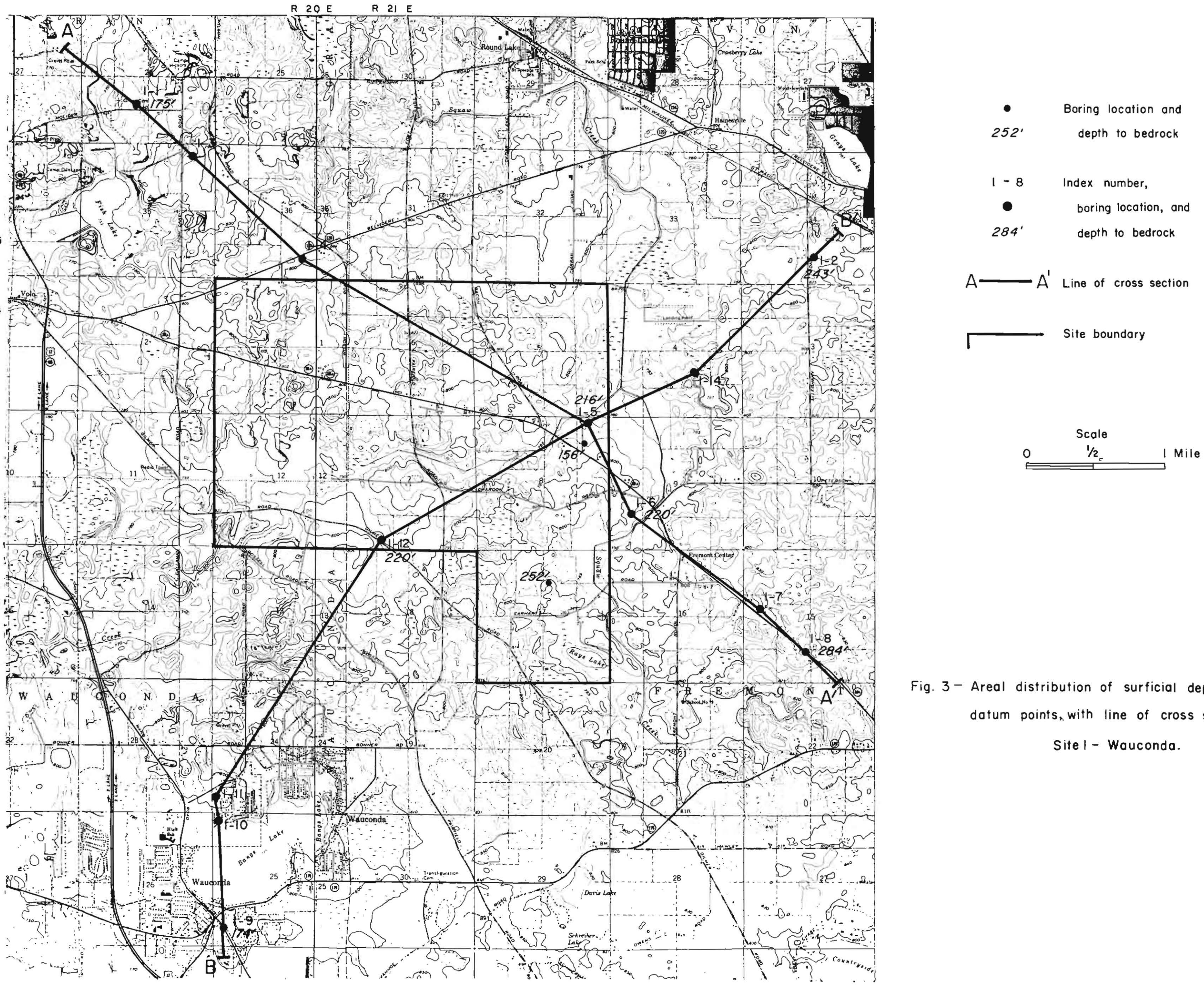


Fig. 3 – Areal distribution of surficial deposits and datum points, with line of cross section, at Site I – Wauconda.

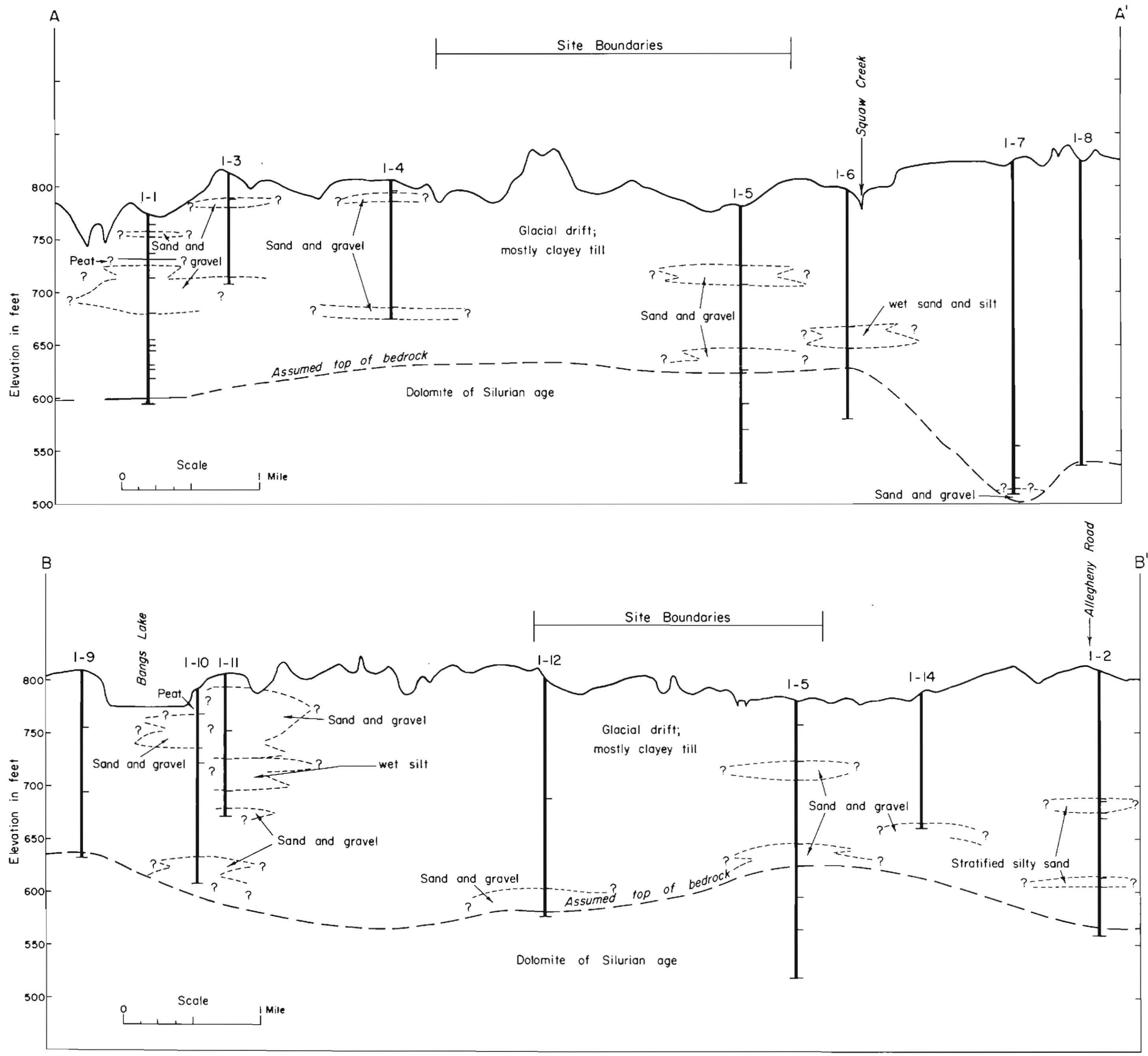


Fig. 4 — Geologic cross sections — Site I - Wauconda

Although borings 1-1 and 1-2 are not within the site boundaries, they may be used with the geologic profiles to give a general idea of the soil characteristics at the Wauconda site. The surface deposits, to a depth of 40 to 50 feet, appear variable, ranging from a clay till of medium consistency to a very stiff till that may contain lenses of silt, sand, and possibly peat. The peat may be restricted to the Fish Lake and Bangs Lake area, because none of the borings within the site indicated peat. Below the 50-foot level the till is stiff to hard, again with lenses of apparently quite dense silt, sand, and gravel. At the site the depth to bedrock averages about 170 feet.

The ring magnet would require deep pile foundations extending either to bedrock at an average depth of about 170 feet and acting as end-bearing piles, or to depths of 100 to 125 feet as friction piles.

The bearing capacity requirement of 4 tons per square foot for the shielding fill and for foundations of appurtenant structures would be met in much of the area, but probably would not be met in parts of the area.

The settlements to be expected under the shielding loads would be small in much of the area where the near-surface deposits are stiff tills, but in other areas settlement might be on the order of a few inches. The piles would need to be isolated from these settlements by sleeves.

Considerable design exploration would be necessary to isolate those areas where the near-surface soil conditions could be sufficiently bad to require special considerations for the shielding fill and the foundations of the appurtenant structures.

Site 2 - South Barrington

Location

The South Barrington site comprises approximately 5000 acres in western Cook County and is situated on the upland east of the Fox River between Barrington and Elgin and is about 4 miles north of Streamwood.

Relief and Drainage

Maximum relief within the site area is 115 feet, but the structure site can be chosen so that the topographic relief would be on the order of 20 to 40 feet. As shown in figure 5, some of the higher prominences are kames, which probably are composed largely of sand and gravel.

Closed depressions are common and often contain ponds and marshes. The central and northwestern portions of the site are drained by Spring Creek, which empties into a small lake located about a mile west of Barrington Hill. The northeastern and southeastern parts of the site area are drained by Poplar Creek, which eventually flows into the Fox River. A more direct drainage route to the Fox River could be developed. Adequate surface drainage of the site would require ditching and tiling.

Geologic Conditions

Depth to bedrock. - As shown by the datum points in figure 5 and by the cross sections in figure 6, the depth to bedrock apparently ranges from about 125 feet to more than 244 feet. The depth to bedrock varies both with the surface topography and with the topography of the bedrock surface. Depth to bedrock increases to the north and east.

Nature of unconsolidated deposits. - The unconsolidated deposits consist principally of glacial till and coarse textured outwash (fig. 5). Outwash sand and gravel predominate in the western part of the site, whereas till is predominant in the rest of the site area. Examination of the cross sections indicates that in the northeastern and eastern parts of the site area glacial till comprises the greater part of the unconsolidated deposits. The till may contain lenses and layers of water-bearing sand and gravel or of silt. Thick deposits of sand and gravel occur in the lower part of the unconsolidated deposits beneath the eastern part of the site area.

Figure 6 also shows that the unconsolidated deposits beneath and near the western part of the South Barrington site are predominantly sand and gravel with some layers of clayey till.

The central part of the site area is underlain by an alternating sequence of till and water-bearing sand and gravel deposits. The thick deposit of sand and gravel shown on both cross sections in figure 6 is a striking feature.

The heterogeneity of glacial drift deposits is evident on the cross sections. The logs of the borings shown on the cross sections are included in this report in Appendix B.

Characteristics of bedrock. - The uppermost bedrock beneath the South Barrington site is dolomite of Silurian age. It is generally firm to hard, locally creviced, more or less cherty in the upper part, may be argillaceous to shaly in the lower part, somewhat jointed or fractured, locally may contain solution channels and be water-bearing. The Silurian dolomite is underlain unconformably by the Maquoketa Formation of Ordovician age.

Ground-Water Regime

Based on elevation of surface water features shown on the topographic map, saturation levels at the South Barrington site are within 30 feet below the land surface. In the areas of silty clay till, the zone of saturation is within 20 feet below land surface, and in the gravel areas, it is 20 to 30 feet below the surface.

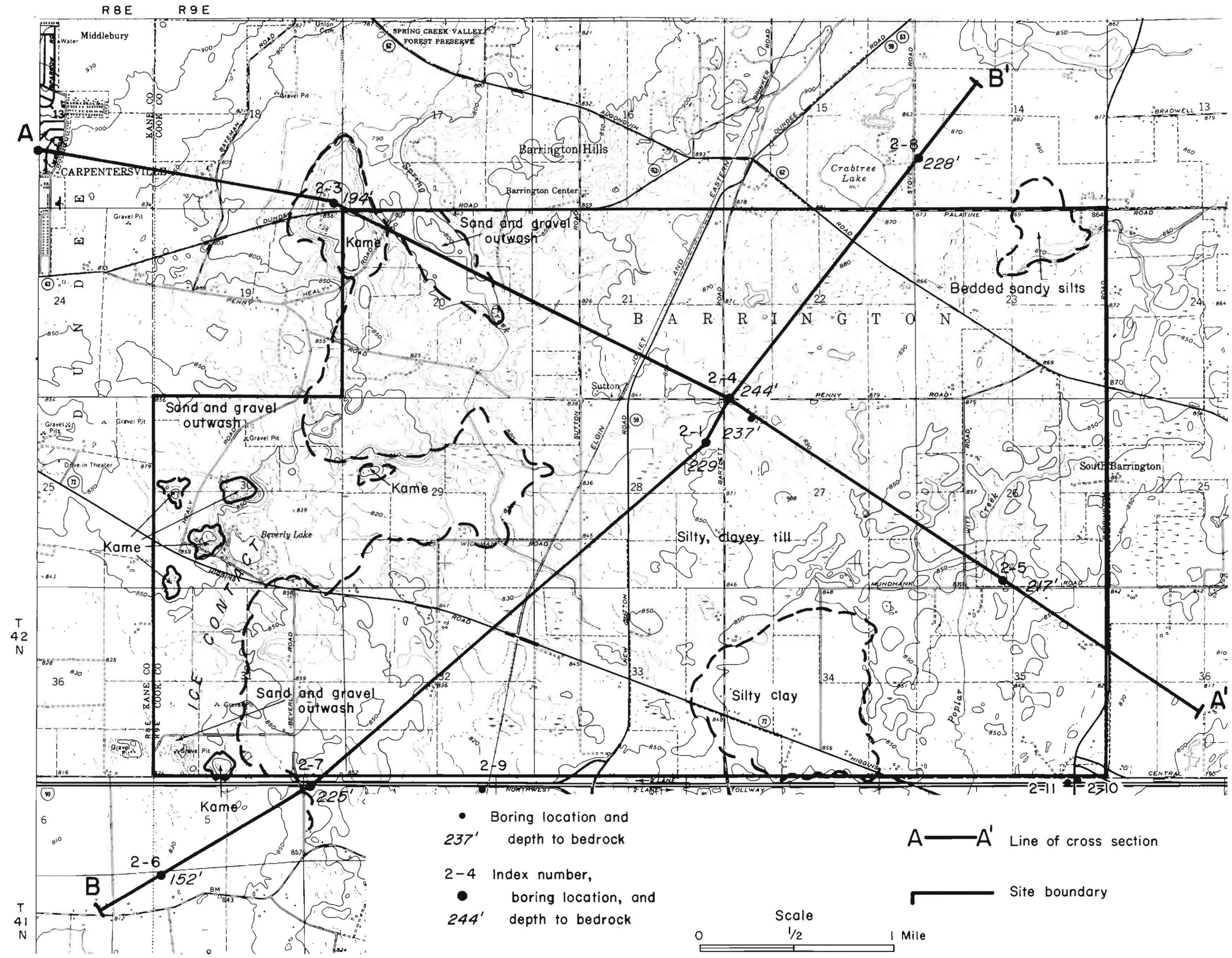
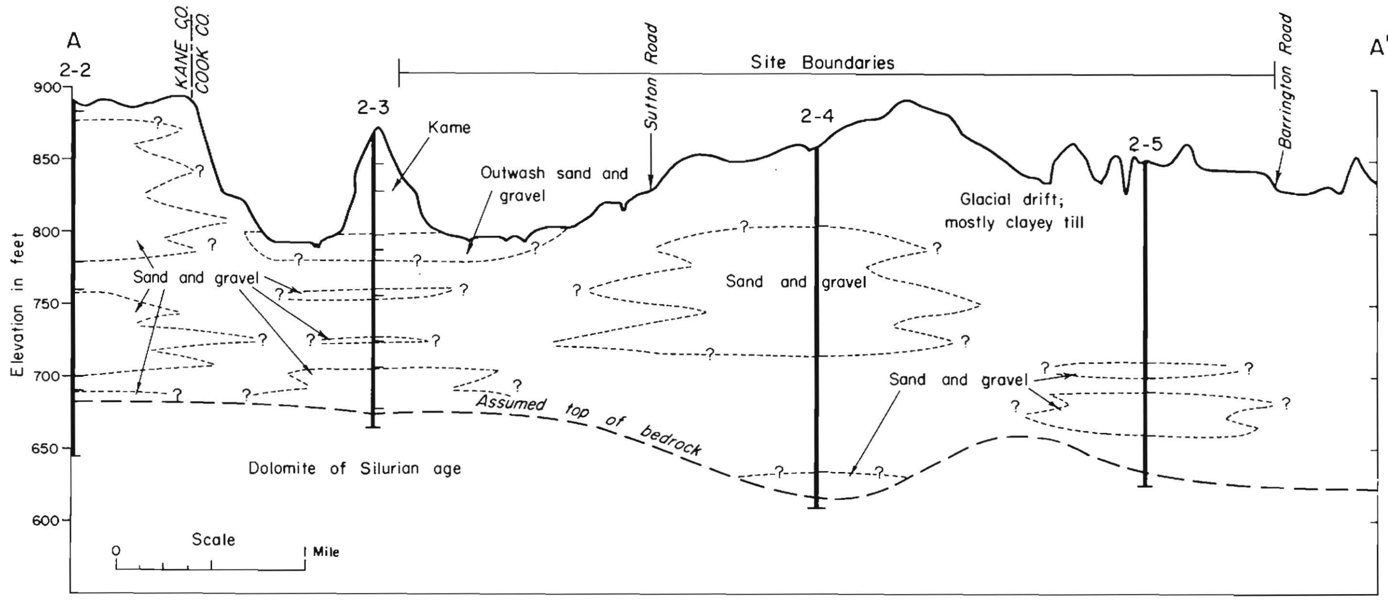


Fig. 5 - Areal distribution of surficial deposits and datum points, with line of cross section, at Site 2 - South Barrington.



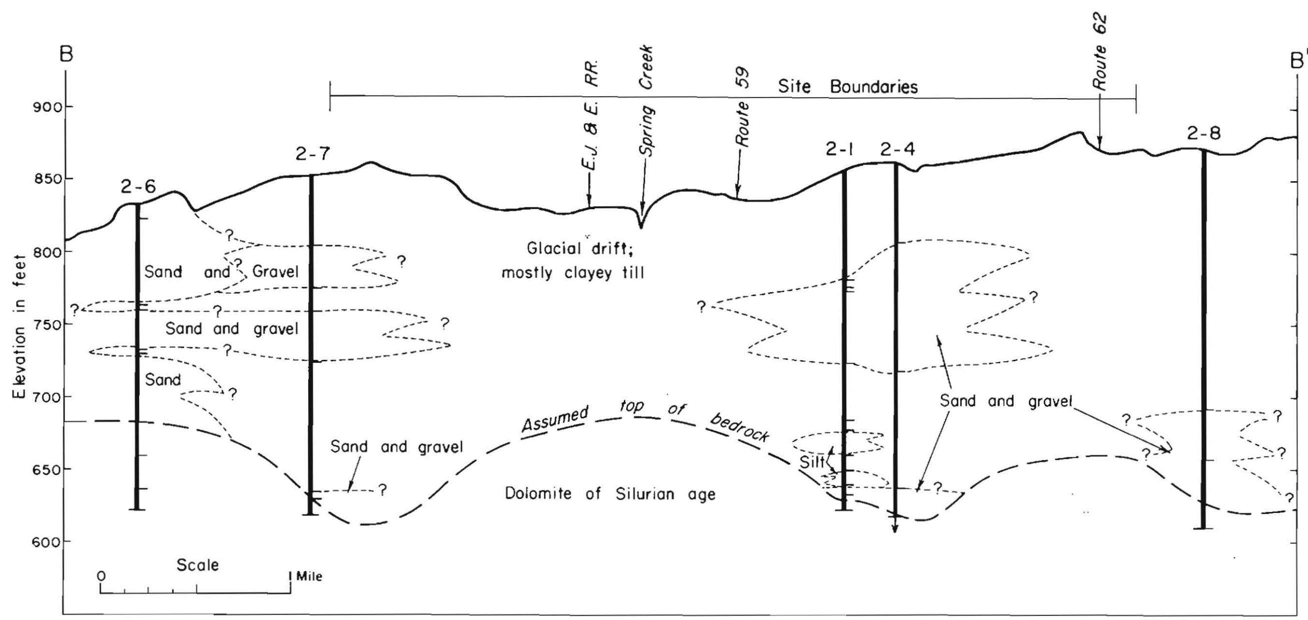


Fig. 6 — Geologic cross sections — Site 2 - South Barrington

Engineering borings from the intersection of the Northwest Tollway and Illinois Highway 59 indicate water levels at 20 to 40 feet below land surface in the gravel below the till.

Foundation Conditions

Excavation. - For the most part, the unconsolidated drift deposits can be excavated with normal earth-moving equipment. Problems, however, may be expected in excavations carried deep into water-bearing silt or sand deposits.

Slope stability. - In the clayey glacial till, cuts having normal slopes should be stable. However, the till above water-bearing layers of silt or sand is subject to stability problems because of piping and sloughing of the silt and sand. Filter layers of coarse sand or gravel may be needed to provide stability during construction and to serve as drains on a permanent basis where such water-bearing materials are encountered. Normal fill slopes constructed of compacted glacial till or of suitable granular material will probably be stable.

Shield material. - Most of the material that would be excavated from the tunnel trench at this site would probably be suitable for use as tunnel shield embankment material.

Load bearing and settlement. - Strength data are available from boring 2-1 near the center of the site and from numerous borings at four overpass structures along the Northwest Tollway, which forms the south boundary of the site (see boring logs in Appendix B). Penetration values and unconfined compressive strengths are tabulated on the logs. The penetration procedure at boring 2-1 consisted of a 475-pound hammer falling 36 inches, while at the other borings a 140-pound hammer was dropped 30 inches.

In boring 2-1 near the center of the site, the upper 77 feet of the profile consists of very stiff to hard clay till with penetration values ranging from 8 to 60 and averaging about 20. The six samples tested in unconfined compression gave values ranging from 3.8 to 9.7 tons per square foot. The till is underlain by 56 feet of sand and coarse gravel in an apparently dense state with penetration values of 62 to more than 100. The sand is underlain by 41 feet of hard clay till with penetration values averaging over 100 and unconfined compressive strengths ranging from 4.2 to more than 9.7 tons per square foot. Layers of black clay, silt, till, stratified silt, and fine sand with some organic inclusions underlie the hard clay till at a depth of 174 feet and continue on down to the bottom of the boring at 229 feet. These materials all have high penetration values, 42 to 100 or more. The natural water contents of the black clay (19.1%) and of the silt with some organic inclusions (16.1%) are not high enough to be alarming. Three cohesive samples showed unconfined compressive strength greater than 9.7 tons per square foot. The Northwest Tollway borings indicate a similar sequence of stiff to hard clay till extending to average depths of 60 to 70 feet and underlain by dense sand. The sand layer was penetrated only 10 feet or so, and the lower till and interbedded silts and sands were not reached by these borings. The upper few feet of the till was of medium to stiff consistency in a few of the borings. (See, for example, the log of boring 2-9.) In most of the borings, however, the till was very stiff to hard from the surface on down. Standard penetration values range from 10 to 80, averaging 20 to 30, with the average compressive strength in the range of 2.5 to 3 tons per square foot, but with considerable scatter. The logs of two borings only a few hundred feet apart, 2-10 and 2-11 (see Appendix B), indicate the variations in water contents, penetration values, and compressive strengths that appear to be typical for this area.

The ring magnet would require deep pile foundations. Friction piles driven to depths of 100 to 125 feet into the stiff to hard clay till, or into the thick lens of dense sand where it occurs, are suggested rather than end-bearing piles to rock because bedrock lies 200 or more feet deep.

Indications are that the bearing capacity requirement of 4 tons per square foot for the shielding fill and for foundations of apparent structures would be met, or nearly so, in most of the area, although in low areas a few feet of somewhat softer material may be encountered.

The settlements to be expected under the shielding loads would be small in most of the area. Where a few feet of the near-surface, softer till occurs, the settlement could be a few inches, however, and the support piles for the ring magnet would need to be isolated from the soil by sleeves.

Because of variations in the stiffness or hardness of the tills and also because of the incidence of sand and silt lenses, the site must be thoroughly explored for design purposes.

Site 3 - Weston

Location

The Weston site comprises approximately 2200 acres in DuPage County and is situated on the upland between the Fox River at Batavia and the West Branch DuPage River.

Relief and Drainage

Maximum topographic relief of the site area is about 55 feet. The average relief over the area that might be encompassed by the accelerator structure is about 20 feet.

The only established drainage lines within the site are Kress Creek and two unnamed creeks that flow eastward into the West Branch DuPage River. Small marshes occur in the upper reaches of the two unnamed creeks in the eastern and southeastern parts of the site area, as shown in figure 7.

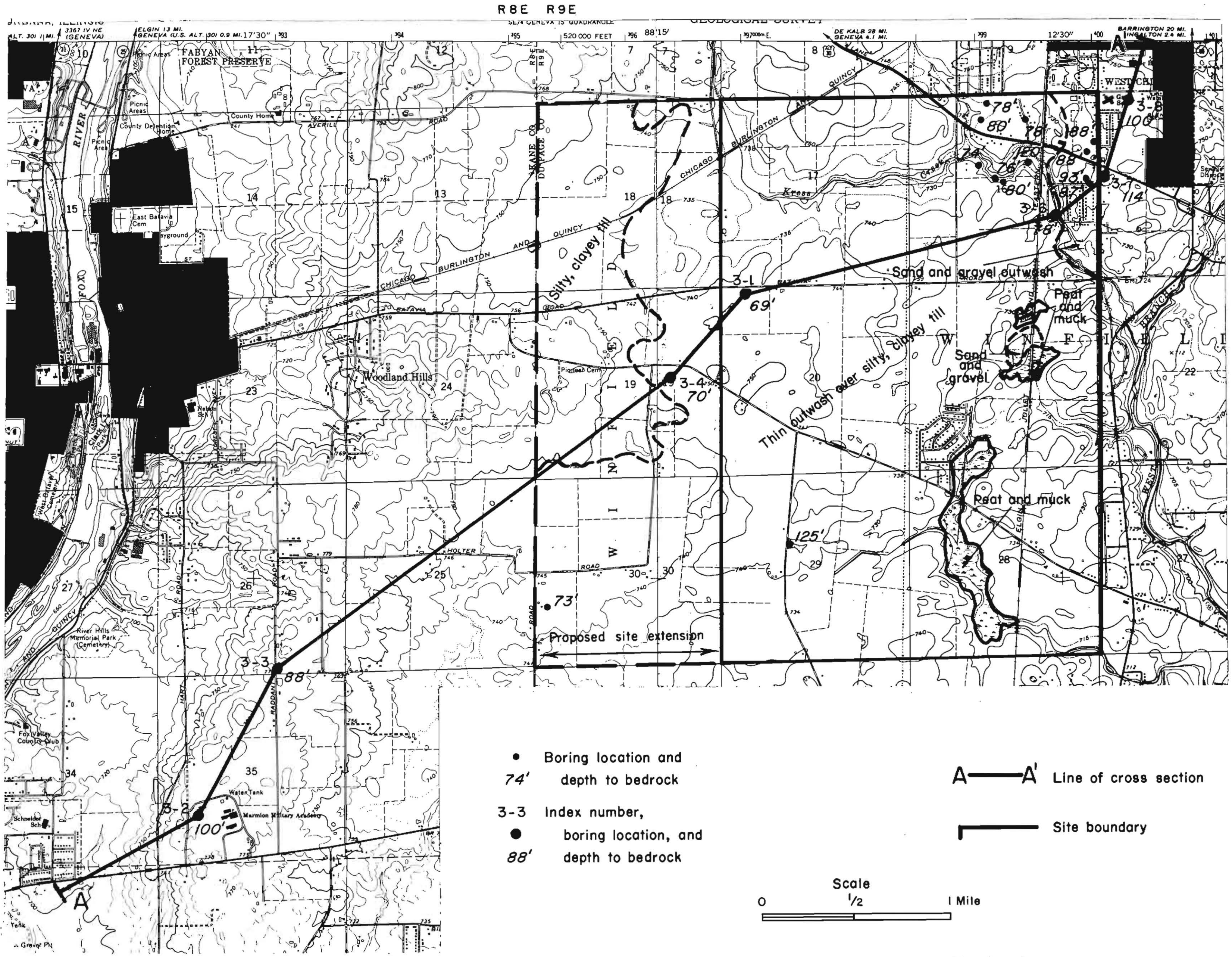


Fig. 7 - Areal distribution of surficial deposits and datum points, with line of cross section, at Site 3 - Weston.

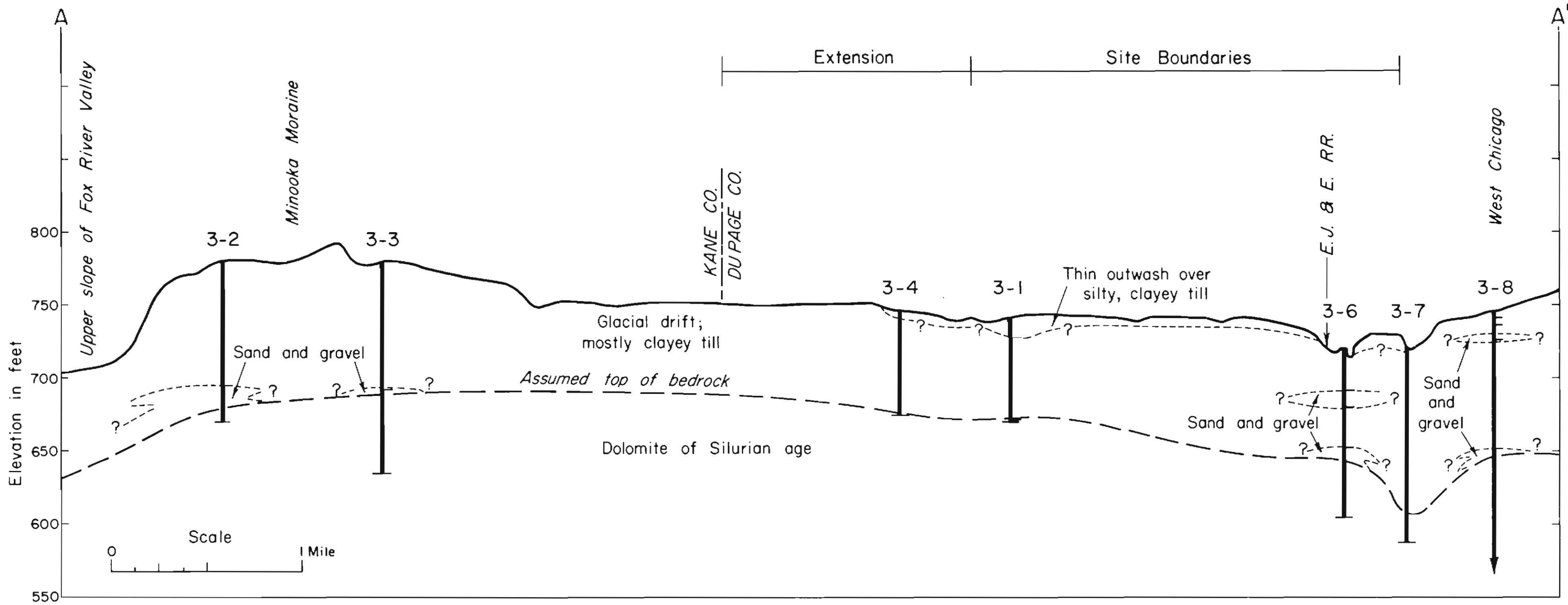


Fig. 8 — Geologic cross section — Site 3 - Weston

Geologic Conditions

Depth to bedrock. - As shown by the datum points in figure 7, the depth to bedrock within the site area, including a possible extension to the west, ranges from about 70 to about 125 feet. In general, the depth to bedrock increases toward the northeast (fig.8).

Nature of unconsolidated deposits. - The unconsolidated materials are glacial drift, and the most abundant material is till, which consists of clay, silt, sand, and pebbles. Deposits of water-bearing sand and gravel are known to be present, intercalated with the clayey till. A thin deposit of water-laid sand and sandy silt overlies the till except in the western part of the proposed site (fig. 7). The till and outwash are overlain by loessial silt, which in boring 3-1 is 8 feet thick.

Characteristics of bedrock. - The uppermost bedrock at the Weston site consists of dolomite of Silurian age. It generally is firm to hard, more or less cherty, especially in the upper part, may be argillaceous to shaly in the lower part, more or less jointed or fractured, locally has surface depressions and contains solution channels, and may be water bearing. The Maquoketa Shale of Ordovician age unconformably underlies the Silurian dolomite.

Ground-Water Regime

From the elevation of permanent water bodies shown on the topographic map, the zone of saturation is estimated to be within 30 feet below land surface throughout most of the site.

Static water levels in numerous wells in the area range from 12 to 60 feet deep. The water levels in the wells near streams are higher, from 12 to 20 feet, than levels in the upland areas, where they average about 35 to 40 feet.

Foundation Conditions

Excavation. - Excavation of the unconsolidated glacial drift materials in the Weston site can be accomplished with normal earth-moving equipment. Excavation difficulties may be encountered in deposits of water-bearing silt or sand.

Slope stability. - In the clayey glacial till, cuts having normal slopes should be stable. However, the till above water-bearing layers of silt or sand is subject to stability problems because of piping and sloughing of the silt and sand. Where such water-bearing materials are encountered, filter layers of coarse sand or gravel may be needed to provide stability during construction and to serve as permanent drains. Fill slopes constructed of compacted clayey till should also be stable at normal construction angles.

Shield material. - Most of the material that would be excavated from the tunnel trench at the Weston site would probably be suitable for use as tunnel shield embankment material.

Load bearing and settlement. - Quantitative data are given in Appendix B regarding shear strength of materials from boring 3-1, which is located northwest of the center of the site. The upper 13 feet of this boring penetrated clayey silt to silt (wind- and water-laid) of medium consistency or density that has penetration values of 9 to 12 and one unconfined compressive strength value of 1.6 tons per square foot. The silt is underlain by 55 feet of very stiff gray clay till with penetration values ranging from 14 to 43 and averaging about 25; it has unconfined compressive strength values ranging from 1.3 to 5.2 tons per square foot, averaging 3 tons per square foot, or slightly more. Refusal was obtained at a depth of 69 feet, and a few limestone fragments were recovered. This depth probably represents the top of the bedrock.

Other borings at and adjacent to the site show a few feet of sand and gravel just above the rock. Occasional lenses of sand and gravel also have been encountered within the till section.

The ring magnet would require pile foundations, and because bedrock is at a depth of only 70 to 125 feet, end-bearing piles on the bedrock surface could be used.

Evidence appears to indicate that the bearing capacity requirement of 4 tons per square foot for the shielding fill can probably be met. The density of the upper 13 feet or so of silty materials is only medium, but the silt would compact under load as the fill is constructed, raising the bearing capacity to an adequate value. Where the silts are excavated, the fill would rest on very stiff tills, and a bearing capacity of 4 tons per square foot would be met, or nearly so. The foundations of appurtenant structures should probably be designed at a somewhat lower pressure.

The settlements to be expected under the fill and shielding loads would probably be a few inches, but settlement would be quite rapid because of the silty nature of the upper materials. Where the upper materials are excavated, the settlements will be much smaller. However, the support piles should probably be separated from the soil by sleeves.

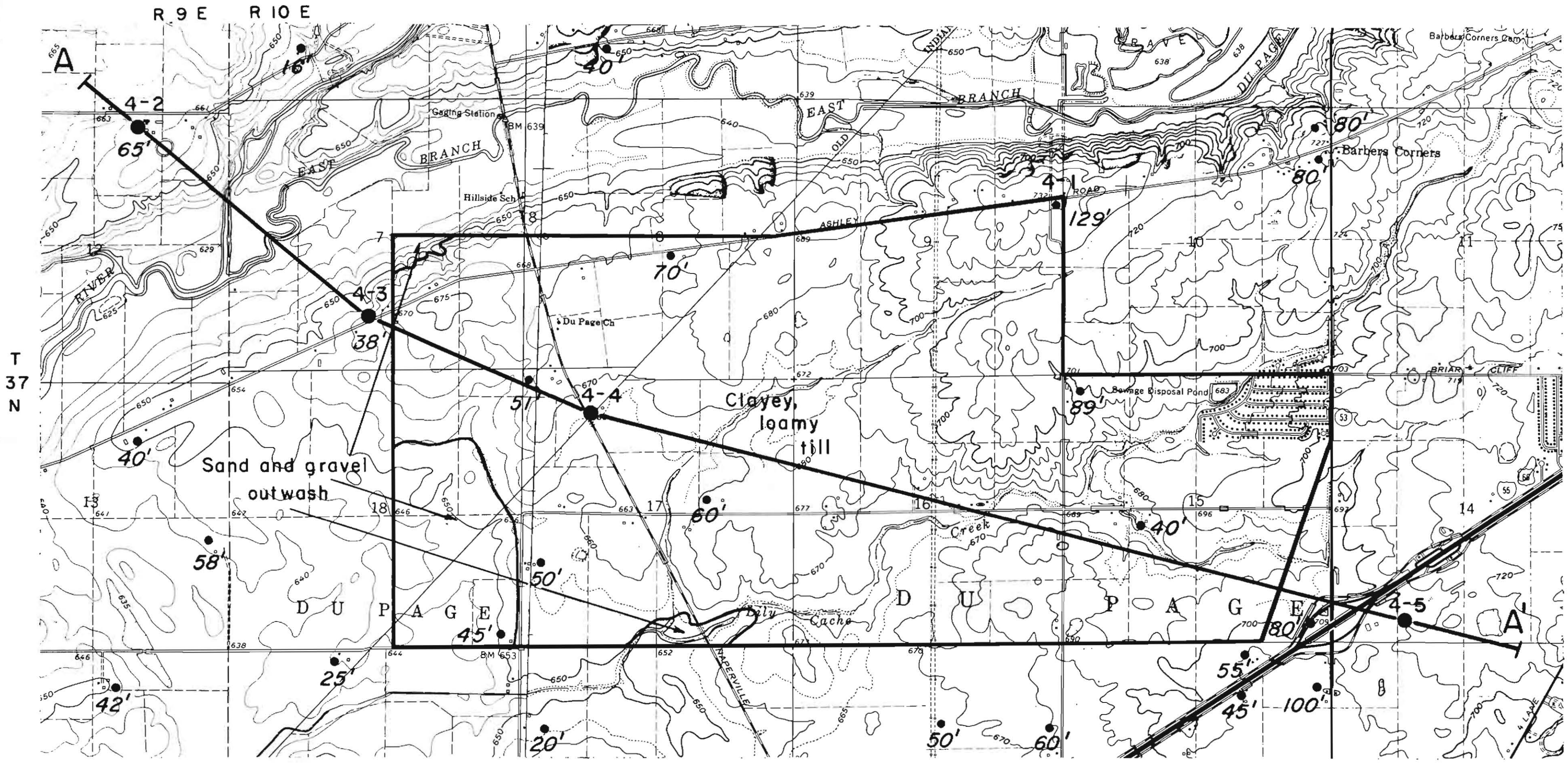
Site 4 - Argonne

Location

The Argonne site comprises approximately 2800 acres in Will County approximately midway between Naperville and Romeoville and about 6 miles west of the Argonne National Laboratory Reservation. The site is situated on the upland between the East Branch DuPage River and U. S. Highway 66.

Relief and Drainage

The site has a maximum topographic relief of about 105 feet, but within the structure area it would be on the order of 30 to 50 feet.



- Boring location and
  65' depth to bedrock

4-3 Index number,
● boring location, and
38' depth to bedrock

A——A' Line of cross section

Site boundary

Scale

0 ½ 1 Mile

Fig. 9 – Areal distribution of surficial deposits and datum points, with line of cross section, at Site 4 – Argonne.

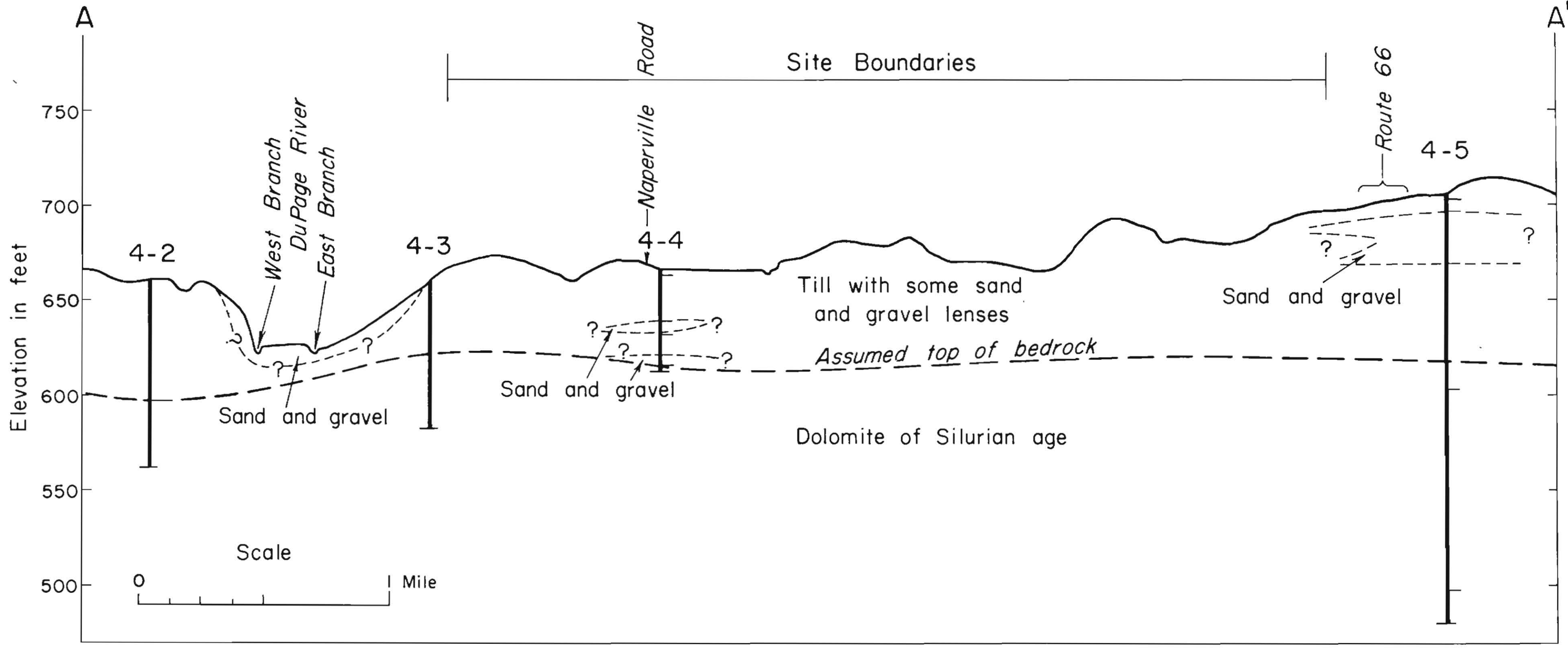


Fig. 10 — Geologic cross section — Site 4 - Argonne

The site is drained by Lily Cache Creek and its headwater tributaries. Lily Cache Creek flows southwestward to the DuPage River. As the site has gently rolling topography, surface drainage is good. However, there are three ephemeral ponds within the site. A new line of drainage could be developed northward to the East Branch DuPage River, which lies just outside the site boundary.

Geologic Conditions

Depth to bedrock. - Depth to bedrock ranges from about 40 feet to 129 feet, and, in general, increases toward the northeast. The depth to bedrock changes with the topography, being greater beneath the higher hills. Depth to bedrock is shown by datum points on figure 9 and on the cross section, figure 10.

Nature of unconsolidated deposits. - Most of the site is underlain by silty clay till, but sand and gravel outwash is probably present in the southwestern part of the site (fig. 9). Boring 4-4, within the site area (fig. 10), reveals a layer of sand and gravel within the till and another zone of sand and gravel at the base of the glacial drift deposits. Boring 4-5, also shown on the cross section (fig. 10) but outside the site boundaries, indicates the unconsolidated glacial drift deposits may consist largely of sand and gravel. The lower 50 feet of gravel in this boring was reported to be cemented. The sand and gravel deposits within the till may be water bearing. The extent of the sand and gravel shown in boring 4-5 is not known.

Characteristics of bedrock. - The uppermost bedrock beneath the Argonne site is dolomite of Silurian age. It is generally firm to hard, more or less cherty in the upper part, may be argillaceous to shaly in the lower part, is more or less jointed or fractured, locally may have surface depressions and solution channels, and may be water bearing. The Silurian dolomite may be about 100 feet thick and is underlain unconformably by the Maquoketa Formation of Ordovician age.

Ground-Water Regime

No perennial water bodies are present on the Argonne site, indicating a relatively deep level of saturation. Based on elevations of permanent water bodies that are adjacent to the site, depth to ground-water saturation is likely to be in excess of 30 feet below land surface in higher upland areas of the site and within 20 feet of land surface in the lower parts of the site.

Foundation Conditions

Excavation. - For the most part, the unconsolidated drift deposits can be excavated with normal earth-moving equipment. However, some blasting might be required if heavy beds of cemented gravel are encountered. Water-bearing silt and sand deposits may also constitute an excavation problem.

Slope stability. - In the clayey glacial till, cuts having normal slopes should be stable. However, the till above water-bearing layers of silt or sand is subject to stability problems because of piping and sloughing of the silt and sand. Filter layers of coarse sand or gravel may be needed to provide stability during construction and to serve as permanent drains where water-bearing materials are encountered. Normal fill slopes constructed of compacted glacial till should also be stable, but the water-bearing silt may not be usable.

Shield material. - Material excavated from the tunnel trench would be suitable for the shield embankment.

Load bearing and settlement. - Strength data are available from boring 4-1 at the northeast corner of the site (see Appendix B for log). Hard clay till occurs from the surface to a depth of 52.5 feet. The penetration values average 40 or more and the unconfined compressive strengths average 4 tons per square foot or more. The hardness of the till in this boring may be due in part to the natural dryness of the till in this location near the steep valley wall of the East Branch DuPage River. Near the center of the site the till may be only of stiff consistency.

The upper till in boring 4-1 is underlain by 55 feet of dense sand and gravel with penetration values of 60 or more. The sand and gravel is underlain by 18 feet of hard silt till having penetration values over 100 and compressive strengths from 2.5 to more than 4.5 tons per square foot.

The bearing capacity requirement of 4 tons per square foot for the shielding fill and for foundations of the appurtenant structures would probably be met in most of the area.

The settlement under the shielding loads would be very small, probably less than 1 inch, because of the small compressibilities of the hard clay till, the dense sand and gravel, and the deeper hard silt till.

The ring magnet could possibly also be constructed directly on the sand and gravel. However, for feasibility studies it would be best to anticipate using end-bearing piles to rock at depths of 40 to 129 feet.

Site 5 - Joliet Arsenal

Location

Joliet Arsenal comprises an area of approximately 42,000 acres in Will County lying between the DesPlaines and Kankakee Rivers, as shown on figure 11. The manufacturing complex of the arsenal lies approximately 10 miles south of Joliet and about 5 miles north of Wilmington. The arsenal property lies partly in the valley of the DesPlaines and Kankakee Rivers and partly on the upland to the east.

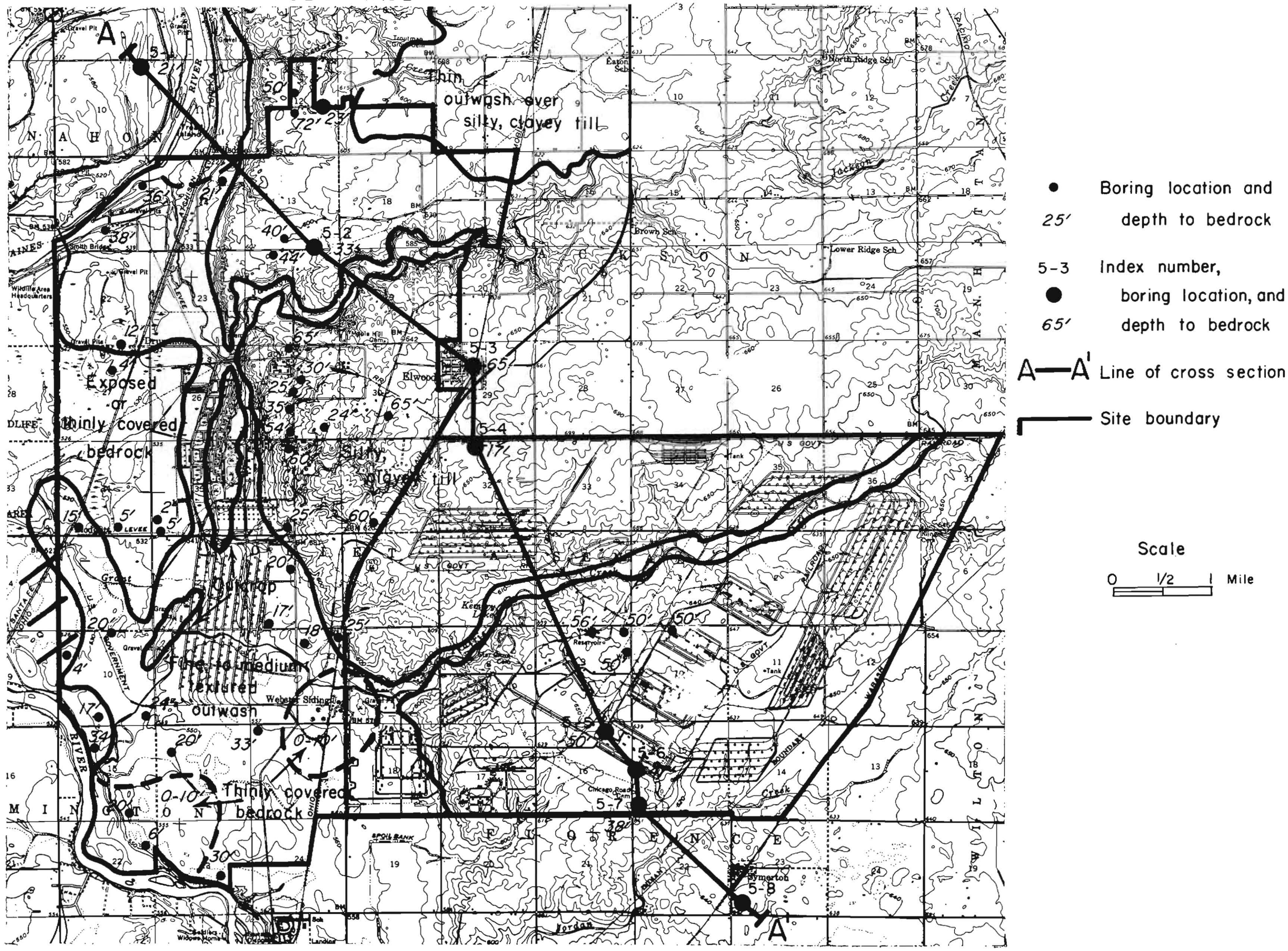


Fig. 11 – Areal distribution of surficial deposits and datum points, with line of cross section, at Site 5 – Joliet Arsenal.

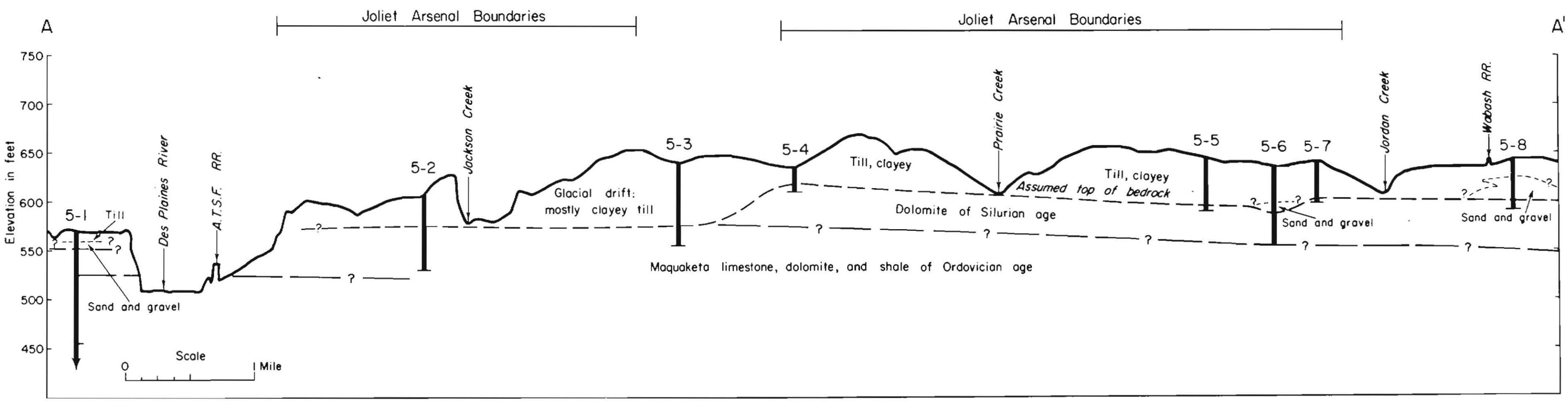


Fig. 12 — Geologic cross section — Site 5 - Joliet Arsenal

Relief and Drainage

The total topographic relief within the arsenal is about 185 to 190 feet. The river valley area has a topographic relief of about 50 feet, and some of the upland areas away from the valley slope also have relief of about 40 or 50 feet.

The northern part of the Joliet Arsenal area is drained by Jackson Creek, which flows into the DesPlaines River within the arsenal boundary. The southern part of the arsenal area is drained by Prairie Creek, which flows into the Kankakee River at the arsenal boundary. Ponds and marshes are present in the valley area along the west side of the arsenal property, indicating that surface drainage of the valley area is not good. The valley area is subject to flooding during periods of excessively heavy rainfall. A small portion of the south part of the arsenal area is drained by Jordan Creek.

Geologic Conditions

Depth to bedrock. - As shown on the cross section in figure 12, bedrock is exposed or thinly covered in the valley area along the DesPlaines River and probably also along the Kankakee River. Bedrock may also be very near the surface along parts of Jackson, Prairie, and Jordan Creeks. In general, the depth to bedrock beneath the uplands changes with the topography (fig. 12). The cross section shows that the bedrock surface was encountered at two different elevations, one below the upland at an elevation of approximately 600 feet and one below the valley and a part of the upland at an elevation of about 575 feet. The break in slope on the bedrock surface and that on the land surface are not, however, coincident. The surface on the bedrock in the valley forms a rock terrace in much of the area. Along the line of cross section, the depth to bedrock ranges from less than 10 feet in the major stream valleys to a maximum of about 80 feet. The depth to bedrock throughout the arsenal area is probably similar to that shown on the cross section (fig. 12).

Nature of unconsolidated deposits. - In the valley area the unconsolidated deposits consist largely of gravel overlain by finer alluvium. The upland areas are underlain by glacial drift that differs in thickness from place to place. The most abundant material making up the drift is a silty clay till, but interbedded deposits of water-bearing silt and of sand and gravel probably are present especially in the basal part of the drift.

Characteristics of bedrock. - Beneath the southern and eastern parts of the Joliet Arsenal area, the uppermost bedrock consists of dolomite of Silurian age, which is generally hard, fine grained, more or less fractured, locally has surface depressions, contains solution channels, and is water bearing. The Silurian dolomite is underlain by the Ordovician Maquoketa Formation, which may consist of limestone, dolomite, or shale. The northern and western parts of the Arsenal area apparently are underlain in part by the Maquoketa Formation, which here consists of limestone and dolomite underlain by brown, dolomitic shale. The Arsenal site is in the area affected by the Sandwich Fault Zone, and faults are probably present in the bedrock. The location and extent of specific faults cannot, however, be defined with existing data. The precise thickness of the various rock units beneath the arsenal area are not known.

Ground-Water Regime

Depth to saturation in the upland area is within 20 feet of land surface, according to elevation of perennial water bodies and records of water levels in the dolomite aquifer beneath the drift. Depth to saturation in the valley area is generally within 10 feet of land surface, except in that part of the valley south of Prairie Creek where it may be as much as 20 feet below land surface.

Foundation Conditions

Excavation. -The unconsolidated materials of the upland area can probably be excavated with normal earth-moving equipment. Blasting would be required to remove bedrock, however, as the dolomite is not a rippable rock.

Slope stability. - In the clayey glacial till, cuts having normal slopes should be stable. However, the till above water-bearing layers of silt or sand is subject to stability problems because of piping and sloughing of the silt and sand. Where water-bearing materials are encountered, filter layers of coarse sand or gravel may be needed to provide stability during construction and to serve as permanent drains. The clayey till should be a satisfactory material for the construction of fills with normal slopes, but materials such as water-bearing silts would probably be of no use.

Shield material. - Unconsolidated material excavated from the trench for the accelerator tunnel could probably be used as shielding fill over the tunnel. Additional material of similar type would be available nearby, if trench excavation did not provide a sufficient volume.

Load bearing and settlement. - Strength data are available from five highway bridge borings located about a mile south of the southeast corner of the Joliet Arsenal site (see the logs of borings 5-8 and 5-9 in Appendix B). The average profile shown by these borings consists of 10 to 15 feet of stiff to hard glacial clay till, with standard penetration values of 12 to 35 and average unconfined compressive strengths of 3 to 4 tons per square foot, overlying 15 to 30 feet of sands and gravels of medium density, i.e., having penetration values averaging 15 to 25. The sands and gravels rest on bedrock at depths ranging from 35 to 45 feet. In two of the borings the bedrock is described as earthy, slightly friable dolomite. In the other three, weathered shale and shaly claystone were encountered. In one boring, different samples of the upper 5 feet of the weathered shale had penetration values of 7 and 26. Within 5 feet and 10 feet, respectively, the values increased to 70 and 300. Whether the different bedrock lithologies are the result of normal stratigraphic changes or of faulting is not known.

The geologic cross section (fig. 12) indicates that the profile described for boring 5-8 may be extrapolated across the upland part of the site with some modifications. Generally, the till thickens and the sand and gravel thins to the northwest. The other site borings indicate that the bedrock is mainly dolomite or limestone.

The ring magnet would probably have to be supported by end-bearing piles to rock. However, because of the possibility of faulting, careful exploration of the bedrock would be necessary. The possibility also exists that the magnet trench could be carried down to the bedrock by excavations perhaps less than 50 feet deep and that the ring foundations could bear directly on rock. However, the problem of the uniformity of the rock would still be a question, although it would be exposed for inspection before the concrete foundation was poured. A second problem encountered with a deep trench foundation to rock is the probable occurrence of ground water in the bedrock and in the deposits of sand and gravel just above the rock.

The bearing capacity requirement of 4 tons per square foot for the shielding fill and the appurtenant structures would be met by the stiff to hard till at the site of boring 5-8, and probably also in the major part of the upland area, but not in the few low undrained areas.

The settlement of the shielding fill would be small. Where the bedrock is shale, the upper few feet of weathered shale would cause some additional settlement. Support piles should be isolated by sleeves.

APPENDIX A

SEISMIC ACTIVITY REPORT FOR DRESDEN NUCLEAR POWER FACILITY OF COMMONWEALTH EDISON COMPANY

Perry Byerly
6037 Contra Costa Road
Oakland, California 94618
Phone 654-6893

III-4-2

March 23, 1965

John A. Blume & Associates-Engineers
612 Howard Street
San Francisco, California 94105

Attention: Mr. H. J. Sexton

Gentlemen:

In studying the history of earthquakes in a region we depend on the written record. This record depends on the dates of settlement of the region by pioneers, on the time of establishment of newspapers, and on the interest of the early citizens in earthquake phenomena.

While southern Illinois has felt a good many shocks, especially those many centering in the New Madrid, Missouri, region, northern Illinois has been comparatively free of earthquake centers and of shocks felt.

In this letter I refer only to "intensities". Remember that "magnitude" is evaluated from the records of seismographs of which the constants (magnification curves) are known. It is only in the last thirty-five years that such evaluation is fairly dependable. Even today there are several ways of obtaining magnitude and various seismographic stations give different values. Also the magnitude computed at a given station depends on the free period of the seismograph used. There is danger that non-seismologists will respect "magnitude" above "intensity" merely because they cannot understand the former whereas they can understand the latter.

Heavier Earthquakes in the Dresden Site Area:

1804, August 20: Fort Dearborn (Chicago) reported a shock. Area over which the shock was felt was reported as 30,000 square miles; no estimate of intensity.

1811, December 16:
1812, January 23
February 7: These were the very great New Madrid (Missouri) earthquakes. They had an intensity of 12 (on the Modified Mercalli Scale) in the epicentral area along the Mississippi near New Madrid. They shook down chimneys in Cincinnati! That they were felt in the Dresden Area is without question, but I can find no indication of how strong they were there. They were said to have been felt in "northern" Canada.

1909, May 26: In Aurora chimneys fell, stove overturned; Bloomington, cracks in brick walls of jail; Chicago, chimneys fell, dishes broken, gas pipes broken; Joliet, chairs overturned, gas mains made to leak; Oak Park, cornice fell. According to Udden's isoseismal map, the Dresden site was in the V-VI range of intensity on the Rossi-Forel Scale. I would make it 7 on the Modified Mercalli Scale.

1912, January 2: Intensity 6 at Aurora, Yorkville and Morris. Probably 6 at the Dresden site.

The above list represents the stronger reported earthquakes which were no doubt felt at the Dresden site (if there were observers there). Looking at the shock of May 26, 1909, I would say that we should build for a shock of intensity 7 on the Modified Mercalli Scale. Going to Hershberger I would say that a design for 0.2 g would be ample.

You have asked me regarding earthquakes centering within 300 miles of the Dresden site.

In the above list there are three shocks which apparently centered in the general region of the Dresden site. Many large more distant centers have been perceptible there.

Centers of sizeable shocks in Illinois as a whole are in number 26 from 1699 to 1962; in Indiana, 10; in Iowa, 2; in Michigan, 7; in Missouri, 32; in Ohio, 16; in Wisconsin, none.

Geologically earthquakes in a midcontinent of fairly even topography are hard to explain. This is particularly so for the devastating New Madrid shocks of 1811-1812.

As to the depth of focus of these shocks, we can say nothing; none were accompanied by clear-cut surface faulting although the shocks of 1811-1812 disturbed the soil greatly over large areas. We can presume that all the shocks originated in the earth's crust of thickness about 30 km.

Very truly yours,

Perry Byerly

Perry Byerly

APPENDIX B

SELECTED ENGINEERING AND WATER WELL RECORDS

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SELECTED ENGINEERING AND WATER WELL RECORDS

Split-tube samplers were used to obtain samples of materials from borings drilled with hollow stem auger or rotary drilling rigs. When the hollow stem auger was used, the split-tube sampler was driven 18 inches by a 140-pound hammer that had a free fall of 30 inches. When the rotary rig was used, the split-tube sampler was driven 18 inches by a 475-pound stem and jar that fell 36 inches on a wire line. The blows were counted for 18-inch penetration rather than the standard 12-inch penetration. The blow-count measurements made with the rotary rigs cannot, as yet, be related directly to measurements obtained in a standard penetration test, but results seem to be consistent.

Unconfined compressive strength measurements of cohesive materials were made at the rig immediately after the split-tube sample was obtained. Under normal circumstances, these measurements were made on a Rimac spring tester and converted to tons per square foot. However, when the samples were badly disturbed, or severe freezing conditions made it difficult to use the spring tester, strength was measured with a pocket penetrometer. The natural moisture content for the cohesive samples is given as percentage of dry weight.

EXPLANATION OF NOTES ON DRILLING RECORDS

The abbreviations and symbols used on the drilling records included in this report are listed below.

Blows/18" - number of blows required to drive the split-barrel sampler 18 inches of penetration. Weight of hammer and length of drop for various depth intervals are indicated on the log heading.

81/2" - number of blows (81) required to drive a split-barrel sampler a certain number of inches (2").

Q_u - unconfined compressive strength expressed in tons per square foot (TSF).

MC - natural moisture content.

SS - split-barrel sampler 1 3/8 inches inside diameter (ID).

2S - split-barrel sampler 2 inches ID.

3S - split-barrel sampler 3 inches ID.

W - wash sample.

ST - Shelby tube

The relations between descriptive terms for relative consistency and the quantitative expressions for these aspects of the materials are shown below.

Relative Consistency

Description	Q_u in TSF
Very soft........	0.0 - 0.25
Soft.............	0.25 - 0.5
Medium...........	0.5 - 1.0
Stiff............	1.0 - 2.0
Very stiff.......	2.0 - 4.0
Hard.............	4.0+

WATER WELL RECORDS

In addition to the logs of borings for which engineering data were obtained, Appendix B includes drillers records of water well and other borings located along the geologic cross sections used in this report. Samples from some of these borings have been examined in the laboratory, principally to determine the stratigraphic sequence of the materials.

Copies of the drillers logs and sample studies are on file at the Illinois State Geological Survey, Urbana.

BORING 1-1 (WAUCONDA), NE SW sec. 26, T. 45 N., R. 9 E.

Surface elevation: 775 ft
Date started: 12-21-62
Date completed: 2-23-63

Boring method: Rotary (0-179 ft)
Hammer weight: 475 pounds
Hammer drop: 36 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	PLEISTOCENE SERIES Till - clay, silty, gray mottled with yellow; traces of sand	1	2S	2.5- 4.0	16	6	1.3	15.9
		2	2S	5.0- 6.5	18	4	1.4	36.1
9.5		3	2S	7.5- 9.0	18	5	1.5	23.6
11.5	Till - silt, clayey, brown	4	2S	10.0-11.5	18	10		18.8
17.0	Silt, gray; traces of clay	5	2S	12.5-14.0	18	11		18.0
22.0	Sand, gray, fine, saturated	6	2S	15.0-16.5	18	12		17.5
		7	2S	17.5-19.0	12	17		
	Till - sand and silt, gray, fine; traces and lenses of coarse sand and gravel	8	2S	20.0-21.5	18	18		
32.0		9	2S	22.5-24.0	13	11		
	Till - clay, silty, brown; traces of sand and gravel	10	2S	25.0-26.5	18	13		14.6
37.0		11	2S	27.5-29.0	18	14	0.9	13.2
	Sand, gray, brown, fine	12	2S	30.0-31.5	10	12		16.6
44.5		13	2S	32.5-34.0	13	27	3.1	12.6
47.5	Peat, brown, fibrous	14	2S	35.0-36.5	4	30		13.3
	Sand, gray-brown, fine, with thin coarse seams; thin clay beds in lower part; stratified	15	2S	37.5-39.0	16	30		
		16	2S	42.5-44.0	10	51		
		17	2S	47.5-50.0	14	37		
62.0		18	2S	52.5-54.0	14	29		
	Gravel, sandy, gray; trace of silt	19	2S	57.5-59.0	16	27		
		20	2S	62.5-64.0	10	62		
		21	2S	67.5-69.0	4	53		

(Continued)

BORING 1-1 (WAUCONDA) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recov- ery (in.)	Blows/18" drop hammer	Q_u	MC
	(Description on preceding page)	22	2S	72.6- 74.0	0	61		
		23	2S	77.6- 78.1	4	110/ 8"		
85.0		24	2S	82.6- 84.0	10	46		
	Gravel, sandy, gray; traces of silt	25	2S	87.6- 89.0	0	77		
94.5			W	92.0- 94.6				
	Till - silt, sandy; some gravel, cobbles, and boulders	26	2S	97.0-102.0	0	not valid		
		27	W	105.0-106.5	4	184		
		28	2S	110.0-111.5	4	100/ 7"		
119.0		29	2S	115.0-116.5	7	150/ 7"	5.2+	8.5
124.0	Clay, pinkish gray; a few silt partings and seams	30	2S	120.0-121.5	12	36	5.2+	21.4
129.5	Till - sand, silty, gray; trace of clay and gravel more clayey	31	2S	125.0-126.5	12	100/17"		10.8
	Clay, pinkish gray; silt layers and partings	32	2S	130.0-131.5	18	100	5.2+	17.3
		33	2S	135.0-136.5	14	50	5.2+	20.8
143.0		34	2S	140.0-141.5	16	50	5.2+	22.8
147.5	Till - clay, silty, pinkish gray; a little sand and gravel; sand seams	35	2S	145.0-146.5	16	100	5.2+	10.7

(Continued)

BORING 1-1 (WAUCONDA) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	Clay, pinkish gray	36A	2S	150.0-151.5	12	100/12"	5.2+	13.5
156.0		36B	2S	155.0-156.5	12	100/14"	5.2+	13.7
163.0	Till - clay, silty, pinkish gray; a little sand and gravel; occasional boulder near base	37	2S	160.0-161.5	4	100/ 8"		
	Till - silt, clayey, brown; a little to some sand and gravel; occasional cobble or boulder	38	2S	165.0-166.5	4	121/12"		
175.0		39	2S	170.0-171.5	0	105/8"		
179.0	SILURIAN SYSTEM Bedrock - dolomitic ls.	40	W	175.0-179.0				
	Bottom of hole at 179.0 feet							

BORING 1-2 (WAUCONDA), SW SE sec. 34, T. 45 N., R. 10 E.

Surface elevation: 809 ft	Boring method:	Hollow auger (0-80 ft)	Rotary (81-246 ft)
Date started: 11-15-62	Hammer weight:	140 pounds	475 pounds
Date completed: 12-19-62	Hammer drop:	30 inches	36 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	PLEISTOCENE SERIES Till - silt, clayey, brown mottled with yellow and gray	1	2S	2.0- 3.5	18	30	2.7	13.9
7.5		2	2S	4.5- 6.0	18	24	4.8	15.4
	Till - clay, silty, gray; trace sand and gravel; a few silt seams and pockets; sand pockets	3	2S	7.0- 8.5	18	21	4.3	16.4
		4	2S	9.5-11.0	12	14	2.8	16.2
		5	2S	12.0-13.5	18	22	4.2	16.1
		6	2S	14.5-16.0	18	24	4.4	17.9
25.0		7	2S	17.0-18.5	18	23	3.7	17.8
	Till - clay, sandy, gray; numerous sand pockets and layers; grades to sand, clayey	8	2S	19.5-21.0	18	26	4.0	18.7
		9	2S	22.0-23.5	18	26	2.9	16.7
		10	2S	24.5-26.0	18	20		9.4
		11	2S	27.0-28.5	18	17	3.3	10.8
		12	2S	29.5-31.0	18	17	2.0	14.9
45.0		13	2S	32.0-33.5	18	24	1.5	14.0
	Till - clay, gray; pebbles	14	2S	34.5-36.0	lost	23		
		15	2S	37.0-39.5	18	27	1.0	10.1
		16	2S	39.5-41.0	2" lost	32		
		17	SS	42.0-43.5	18	23	1.8	16.0
		18	2S	44.5-46.0		17	2.9	17.1
		19	2S	47.0-48.5		22	2.9	

(Continued)

BORING 1-2 (WAUCONDA) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recov-ery (in.)	Blows/18" drop hammer	Q_u	MC
	(Description on preceding page)	20	2S	49.5- 51.0		38	1.5	
		21	2S	52.0- 53.5		21	2.1	20.5
76.5		22	2S	54.5- 56.0	0	31		
	Till - silt, clayey, gray; trace of sand and gravel; clay fraction increases with depth; at approximately 87 feet clay is predominant, sand absent	23	2S	57.0- 58.5		49	2.2	18.6
		24	2S	59.5- 61.0		50	2.0	
		25	2S	62.0- 63.5		61	2.5	
		26	2S	64.5- 66.0		85	2.0	
		27	2S	67.0- 68.5		119	5.2+	14.8
		28	2S	69.5- 71.0		60	4.3	17.4
104.0		29	2S	72.0- 73.5		46	3.9	17.2
	Till - silt, clayey, gray-brown, with traces of sand interspersed and in lenses; sand fraction decreases downward	30	2S	74.5- 76.0		120	4.9	16.3
		31	SS	77.0- 78.5		90	6.8	13.9
		32	SS	79.5- 81.0	5	108		
120.0		32A	2S	82.0- 83.5	5	22		22.8
122.0	Silt, gray, stratified	33	2S	84.5- 86.0	17	28	5.8	22.1
	Sand, fine to coarse, well sorted, interbedded with silt (stratified)	34X	2S	87.0- 88.5	6	30		24.4
		34	2S	89.5- 91.0	17	18	2.3	23.2
134.0		35	2S	92.0- 93.5	19	28	2.1	25.0
	Till - clay, silty, brown mottled with gray; traces of sand and gravel	36	2S	94.5- 96.0	8	38	9.3	23.2
139.0		37	2S	97.0- 98.5	8	not valid	5.5	22.3
		38	2S	99.5-101.0	12	62	3.5	23.2

(Continued)

BORING 1-2 (WAUCONDA) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
		39	2S	105.0-106.5	18	33	3.1	11.0
		40	2S	110.0-111.5	0	60		
		41	2S	115.0-116.5	5	42	-	18.3
		42	2S	120.0-121.5	18	44		15.0
		43	2S	125.0-126.5	7	96		
		44	2S	130.0-131.5	13	98		
		45	2S	135.0-136.5	5	10		
	Silt, clayey, gray to brown; occasional boulders or sand beds; boulders at 182 to 185 feet	46	2S	140.0-141.5	10	not valid	4.6	17.0
		47	2S	145.0-146.5	18	24	3.5	16.5
		48	2S	150.0-151.5	12	59	9.3	17.6
		49	2S	155.0-156.5	18	62		
		50	2S	160.0-161.5	12	69		
		51	2S	165.5-167.0	4	52		
		52	2S	170.0-171.5	0	38		
		53	2S	175.0-176.5	18	44	4.5	13.3
195.0		54	2S	180.0-181.5	18	38	9.7	15.4
	Sand, silty, gray, fine; thin beds of brown clay (1 to 3"); occasional cobble or boulder; stratified	55	2S	185.0-186.5	18	47		20.9
		56	2S	190.0-191.5	18	58	7.2	17.5
204.0		57	2S	195.0-196.5	18	103		
	Till - silt, clayey, brick red, very hard; trace of sand and occasional cobble; clay content increases with depth	58	2S	200.0-201.5	18	93		
		59	2S	205.0-206.5	4	84		16.6

(Continued)

BORING 1-2 (WAUCONDA) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recov-ery (in.)	Blows/18" drop hammer	Q_u	MC
	(Description on preceding page)	60	2S	210.0-211.5	18	93	9.7	17.5
		61	2S	215.0-216.5	20	84	9.7	15.9
228.0		62	2S	220.0-221.5	20	68	9.7	20.2
	Till - silt, clayey, gray, stiff; some to little sand and gravel	63	2S	225.0-226.5	20	63		24.1
		64	2S	230.0-231.5	14	102		6.9
		65	2S	235.0-236.5	12	101		9.1
243.5		66	2S	240.0-241.5	6	120		7.9
246.0	* Dolomite, gray, white (magnesium?)	67		243.5-246.0				
	Bottom of hole at 246.0 feet							

* SILURIAN SYSTEM

BORING 1-3 (WAUCONDA)

Boring 1-3, NE NE sec. 35, T. 45 N., R. 9 E. Elevation 812 feet. Drilled by Hoover Well Drilling Service in 1963.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, stony, yellow	19
Clay, soft, blue	25
Sand	32
Clay, blue	70
Clay, sandy, blue	98
Sand	104

BORING 1-4 (WAUCONDA)

Boring 1-4, SW SE sec. 36, T. 45 N., R. 9 E. Drilled by Charles Madsen and Sons in 1952.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Soil	2
Clay, yellow	10
Sand, fine	20
Clay	120
Sand, fine	125
Sand, coarse	131

BORING 1-5 (WAUCONDA)

Boring 1-5, NE NE sec. 8, T. 44 N., R. 10 E. Elevation 795 feet. Drilled by Henry Boysen, Jr., in 1941.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Topsoil	2
Clay, yellow	22
Clay, blue	57
Sand	75
Clay, blue	135
Gravel	156
SILURIAN SYSTEM	
Rock	186
Shale	216
Limestone	262

BORING 1-6 (WAUCONDA)

Boring 1-6, NW SW sec. 9, T. 44 N., R. 10 E. Elevation 797 feet. Drilled by Henry Boysen, Jr., in 1944.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow	20
Clay, stony, blue	130
Quicksand and rubber clay	150
Clay, grit, and stones	169

(Continued)

BORING 1-6 (WAUCONDA) - Continued

Description of material	Depth (ft)
SILURIAN SYSTEM	
Rock, gray, red-brown	210
Bit blew water	215

BORING 1-7 (WAUCONDA)

Boring 1-7, SW NW sec. 15, T. 44 N., R. 10 E. Elevation 825 feet. Drilled by Fred Kiene and Son in 1940.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay	270
Sand and gravel, white	300
Boulders, sand and gravel and clay mixture	310
Gravel, clean; water	314

BORING 1-8 (WAUCONDA)

Boring 1-8, SE SW sec. 15, T. 44 N., R. 10 E. Elevation 825 feet. Drilled by H. R. Luebbe.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Drift	284
SILURIAN SYSTEM	
Limestone	285

BORING 1-9 (WAUCONDA)

Boring 1-9, SW SW sec. 25, T. 44 N., R. 9 E. Drilled by W. R. Boetsch and Son in 1942.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Topsoil	5
Sand and clay, fine, brown	55

(Continued)

BORING 1-9 (WAUCONDA) - Continued

Description of material	Depth (ft)
PLEISTOCENE SERIES - Continued	
Clay, soft, gray	116
Sand and clay, soft, gray	174
SILURIAN SYSTEM	
Lime rock, water	177

BORING 1-10 (WAUCONDA)

Boring 1-10, NW NW sec. 25, T. 44 N., R. 9 E. Drilled by C. L. Wertz in December 1952.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Peat bog	23
Sand	70
Clay	158
Sand and gravel	178
Gravel, white	182

BORING 1-11 (WAUCONDA)

Boring 1-11, SW SW sec. 24, T. 44 N., R. 9 E. Elevation 804 feet. Drilled by Hoover Well Service in 1963.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow	12
Gravel	53
Sand, fine	80
Clay, soupy	110
Clay, blue	127
Gravel	134

BORING 1-12 (WAUCONDA)

Boring 1-12, SW SW sec. 7, T. 44 N., R. 10 E. Elevation 800 feet. Drilled by H. Boysen.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Drift clay	115
Clay and sand	150
Clay and sand	200?
Gravel	220
SILURIAN SYSTEM	
Rock	228

BORING 1-14 (WAUCONDA)

Boring 1-14, NW SE sec. 4, T. 44 N., R. 10 E. Elevation 792 feet. Drilled by Fred Kiene in 1938.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay	124
Gravel	126

BORING 2-1 (SOUTH BARRINGTON), NE NE sec. 28, T. 42 N., R. 9 E.

Surface elevation: 862 ft
Date started: 11-28-62
Date completed: 12-7-62

Boring method: Rotary (0-229 ft)
Hammer weight: 475 pounds
Hammer drop: 36 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	PLEISTOCENE SERIES	1	2S	5.0- 6.5	8	44	9.3	17.5
	Till - silt, clayey, light brown; traces of sand and gravel	2	2S	10.0-11.5	18	18	9.3	20.0
11.0								
	Till - clay, silty, gray; traces of sand and gravel; lenses of sand also observed	3	2S	15.0-16.5	14	10	3.8	15.5
		4	2S	20.0-21.5	4+	12		20.4
		5	2S	25.0-26.5	6	8		19.9
		6	2S	30.0-31.5	12	18		21.1
		7	3S	35.0-36.5	16	28		
		8	3S	40.0-41.5	18	20	9.7	17.6
		9	2S	45.0-46.5	18	25	6.0	
		10	2S	50.0-51.5	20	28	5.6	16.0
		11	2S	55.0-56.5	18	40		20.6
		12	2S	60.0-61.5	0	60		
		13	2S	65.0-66.5	0	not valid		
		14	2S	70.0-71.5	0	Refusal		
		15		75.0-	cuttings	Refusal		

(Continued)

BORING 2-1 (SOUTH BARRINGTON) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
77.0	(Description on preceding page)							
81.0	Gravel, sandy, silty, coarse; cobbles and boulders	16	3S	80.0- 81.5	18	170		
84.0	Sand, gray, well sorted; thin layers of gray-brown silt							
133.0	Gravel, sandy, silty, gray, coarse; traces of cobbles and boulders; a few beds of sorted sands; boulder beds at 131.0 feet; lower part of section very coarse	17	3S	85.0- 86.5	7	82		
		18	2S	90.0- 91.5	8	100		
		19	2S	95.0- 96.5	6	not valid		
		20	2S	100.0-101.5	0	R		
		21	2S	105.0-106.1	12	not valid		
		22	3S	110.0-111.5	6	212		
		23	3S	115.0-116.5	10	not valid		
		24	2S	120.0-121.5	12	103		
		25	2S	125.0-126.5	0	R		
		26	2S	130.0-131.5	0	R		

(Continued)

BORING 2-1 (SOUTH BARRINGTON) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	Till - clay, silty, red-brown; traces of sand and gravel; about 12" of gray till on top; streaks of gravel	27	2S	134.0-135.5	8	62		13.6
		28	2S	140.0-141.5	0	113		
		29	2S	145.0-146.5	18	213	7.4	13.5
		30	2S	150.0-151.5	16	231	9.7+	12.7
		31	2S	155.0-156.5	16	103	9.7+	11.9
		32	2S	160.0-161.5	18	85	5.8	10.5
		33	2S	165.0-166.5	18	62	5.6	11.4
		34	2S	170.0-171.5	18	42	4.7	11.6
174.0								
	Clay, black; trace of sand and silt	35	2S	175.0-176.5	18	97	9.7+	19.1
180.0		36	2S	180.0-181.5	18	94	9.7+	16.1
184.0	*							
	Silt, light brown	37	2S	185.0-186.5	18	45		22.5
		37A	2S	190.0-191.5	14	42		
		38	2S	195.0-196.5	10	52		
197.0								
	Till - silt, clayey, red-brown; a trace of sand and gravel	39	2S	200.0-201.5	18	82	9.7+	16.1
		40	2S	205.0-206.5	10	87		18.1
208.0								
	Silt, red to brown, stratified; some organic inclusions; changes to fine sand at 215 feet	41	2S	210.0-211.5	18	45		19.9
		42	2S	215.0-216.5	14	120		
218.0								

* Silt, clayey, green; little to trace of sand, gravel, and shale fragments.

(Continued)

BORING 2-1 (SOUTH BARRINGTON) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
225.0	Gravel, gray; silt, sand, and cobbles	43	2S	220.0-221.5	4	122		
229.0	Till - silt, sandy, gray-brown; trace of clay and coarse sand; some cobbles	45	2S	226.0-226.7	4	172(R)		
	Bottom of hole at 229.0 feet							

BORING 2-2 (SOUTH BARRINGTON)

Boring 2-2, NE SW sec. 13, T. 42 N., R. 8 E. Drilled by Sherman Holman on March 17, 1954.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Soil	8
Clay, red	14
Sand and gravel	112
Clay, blue	132
Sand and gravel	192
Shale	202
Sand and gravel	210
SILURIAN SYSTEM	
Limestone and sand	247

BORING 2-3 (SOUTH BARRINGTON)

Boring 2-3, SE SE sec. 18, T. 42 N., R. 9 E. Elevation 863 feet. Drilled by Rieke Well Drilling Co.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Gravel, clayey, sandy, buff	20
Sand, clayey, fine to very coarse, buff	40
Gravel, sandy, clayey, light brown; average 1/8" diameter	70

(Continued)

BORING 2-3 (SOUTH BARRINGTON) - Continued

Description of material	Depth (ft)
PLEISTOCENE SERIES - Continued	
Sand, fine to very coarse, buff	80
Gravel, slightly sandy, slightly clayey, gray; average 3/16" diameter	87
Till, slightly pebbly, pinkish gray	107
Gravel, very sandy, very clayey, pinkish gray; pebbles up to 1/4" diameter	112
Till, sandy, pink	140
Gravel, slightly clayey, dark pinkish brown; average 1/8" diameter	144
Till, sandy, pale pink to bright pink	161
Gravel, sandy, angular, buff	183
Gravel, clayey, very sandy, buff; pebbles up to 3/8" diameter	191
Sand, pebbly, clayey, buff	194
SILURIAN SYSTEM	
Dolomite, slightly cherty, finely crystalline, gray-buff	198

BORING 2-4 (SOUTH BARRINGTON)

Boring 2-4, SW SW sec. 22, T. 42 N., R. 9 E. Elevation 851 feet. Drilled by Peter Sneltin in November 1941.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow	12
Clay, blue; boulders	32
Clay, blue	55
Sand, packed	145
Hard pan, red	225
Sand and gravel	244
SILURIAN SYSTEM	
Rock	261

BORING 2-5 (SOUTH BARRINGTON)

Boring 2-5, SE SW sec. 26, T. 42 N., R. 9 E. Drilled by Rieke Well Drilling Company in 1932.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till, calcareous, argillaceous, silty, slightly sandy and pebbly, yellowish brown	20
Till, calcareous, argillaceous, silty, slightly sandy and pebbly, brownish gray	130
Same; a few more pebbles	140
Gravel, dirty, mostly light gray dolomite	150
Till, calcareous, silty, sandy, pebbly, brownish gray	160
Sand and fine gravel, dirty, brownish gray; many fine dolomite crystals	190
Till, calcareous, silty, argillaceous, sandy, brownish gray; numerous very fine crystals of dolomite; no pebbles	217
SILURIAN SYSTEM	
Dolomite, very fine to fine, white to very light gray with few pinkish buff spots	222

BORING 2-6 (SOUTH BARRINGTON)

Boring 2-6, NW NW sec. 8, T. 41 N., R. 9 E. Elevation 829 feet. Drilled by Niemeyer and Son in 1940.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Gravel, coarse	10
Sand, fine	70
Clay, yellow	73
Sand, fine	100
Clay, blue	103
Sand, fine	152
SILURIAN SYSTEM	
Limestone	172
Sandstone	197
Shale, blue	210

BORING 2-7 (SOUTH BARRINGTON)

Boring 2-7, NW NW sec. 4, T. 41 N., R. 9 E. Elevation 860 feet. Drilled by J. P. Miller. Studied by C. L. Horberg, June 1946.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
WISCONSINAN STAGE	
Till, calcareous, oxidized, yellow	35
Till, gravelly, calcareous, yellowish gray	45
Gravel, sandy, up to 1/4" diameter	50
Gravel, up to 1" diameter, clean	55
Gravel, sandy, up to 1/2" diameter, clean	80
Till, calcareous, gray	90
Till, gravelly, calcareous, yellow, oxidized	95
Sand, coarse, gravelly, silty, calcareous, brownish gray, pink tint	130
Till, calcareous, maroon (Bloomington-Normal)	140
Till, gravelly, pinkish gray	145
Till, gravelly, pinkish gray, trace of humus	150
Same, maroonish gray	165
Till, calcareous, very gravelly	220
Sand, medium, silty, largely dolomite	225
SILURIAN SYSTEM	
Dolomite, crystalline, white	235

BORING 2-8 (SOUTH BARRINGTON)

Boring 2-8, NW SW sec. 14, T. 42 N., R. 9 E. Drilled by Rieke Well Drilling Co. in 1930. Studied by S. E. Ekblaw, December 1930.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till, slightly pebbly, buff to brown	35
Till, slightly sandy, with grains of white dolomite, gray	60
Till, finely sandy, light gray (sand is quartz)	65
Till, light gray; white dolomite grains	75
Till, slightly silty, light gray	120
Till, silty, light gray; grains and small pebbles of white dolomite	153
Till, silty, slightly sandy (mostly grains of white dolomite), buff	180
Sand, clayey, very fine to pebbly, gray	195
Sand, very fine to pebbly, gray	200
Sand, clayey, very fine to pebbly, light gray; most grains of white dolomite	215
Gravel, sandy, up to 3/8" diameter; mostly dolomite, white to buff	228

BORING 2-9 (SOUTH BARRINGTON), NE SE sec. 4, T. 41 N., R. 9 E.
NORTHERN ILLINOIS TOLL HIGHWAY N-6, WS-44

Surface elevation: 820.8 ft
Date started: 6-14-56
Date completed: 6-14-56

Boring method:
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
3.0	PLEISTOCENE SERIES *	1		1.8- 3.3		6		
8.0	Clay, silty, brown; trace sand and gravel	2	SS	4.3- 6.8		8	2.8	18
	Clay, silty, gray; trace sand and gravel	3	SS	6.8- 8.3		25	2.5	17
		4	SS	9.3-10.8		20	4.3	15
		5	SS	11.8-13.3		26	2.4	15
		6	SS	14.3-15.8		19	1.9	18
		7	SS	16.8-18.3			3.2	17
		8	ST	19.3-20.8		18	1.4	19
		9	SS	25.8-27.3		23	3.9	21
		10	SS	30.8-32.3			1.4	17
		11	SS	35.8-37.3		15	1.5	17
		12		40.8-42.3				
		13	SS	45.8-47.3		60	2.0	13
		14	SS	50.8-52.3		16	1.1	17
		15	ST	55.8-57.3		19	1.1	19
		16	SS	60.8-62.3		18	1.8	21
		17		65.8-67.3		25		
		18	SS	70.8-72.3		26	2.2	17

* Silt, clayey, brown-gray; trace sand, organic

(Continued)

BORING 2-9 (SOUTH BARRINGTON) - Continued

Depth (1"=10')	Description of material	No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
	(Description on preceding page)	19	SS	75.8-77.3		48	2.1	19
78.3								
	Sand, gravelly, gray; trace silt	20		80.8-82.3		60		
86.0		21		85.5-87.0		110		
	Bottom of hole at 86.0 feet							

BORING 2-10 (SOUTH BARRINGTON), NW SW sec. 6, T. 41 N., R. 10 E.
NORTHERN ILLINOIS TOLL HIGHWAY N-6, WS-26

Surface elevation: 820.7 ft
Date started: 5-26-56
Date completed: 5-26-56

Boring method:
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material	Samples						
		No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
1.0	*							
	PLEISTOCENE SERIES	1	ST	1.8- 3.3		10	1.8	25
5.5	Clay, sandy, silty, gray-brown	2		4.3- 5.8		19		17
8.0	Clay, sandy, silty, brown; trace gravel	3		6.8- 8.3		28		16
13.0	Clay, gravelly, sandy, silty, brown	4		9.3-10.8		35		15
		5	ST	11.8-13.3		21	3.4	15
		6	ST	14.3-15.8		20	2.5	16
	Clay, silty, gray; trace sand and gravel	7	ST	16.8-18.3		21	1.1	18
28.0		8	ST	19.3-20.8		9	2.3	15
		9		25.5-27.0				
33.0	Clay, silty, brown; trace sand and gravel	10	ST	30.5-32.0		25	3.8	17
		11	SS	35.8-37.3		26	1.7	21
		12	SS	40.8-42.3		26	2.2	21
	Clay, silty, gray; trace sand and gravel	13	SS	45.8-47.3		25	1.5	21
53.3		14	SS	50.8-52.3		25		22
55.2	Sand, gravelly, gray	15		55.1-		100/ 2"		
	Bottom of hole at 55.2 feet							

* Topsoil, black

BORING 2-11 (SOUTH BARRINGTON), NE SE sec. 1, T. 41 N., R. 9 E.
NORTHERN ILLINOIS TOLL HIGHWAY N-6, WS-27

Surface elevation: 820.4 ft
Date started: 5-27-56
Date completed: 5-27-56

Boring method:
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
1.0	Sand	1		1.8		13		18
	PLEISTOCENE SERIES Clay, sandy, silty, gray-brown; trace gravel	2	SS	4.3		30	4.2	19
10.5		3	SS	6.8		27	5.0	19
		4	ST	9.3		24	3.5	15
		5	SS	11.8		32	1.7	15
		6	SS	14.3		77	1.7	17
		7	SS	16.8		29	2.3	17
	Clay, sandy, silty, gray; trace gravel	8	SS	19.3		35	1.2	20
		9	SS	26.8		37	2.6	16
		10	SS	30.8		40	1.1	17
38.3		11	SS	35.8		73	4.5	12
43.0	Clay, silty, gray; trace sand and gravel	12	SS	42.3		61	2.4	18
	Bottom of hole at 43.0 feet							

BORING 3-1 (WESTON), NW NW sec. 20, T. 39 N., R. 9 E.

Surface elevation: 742 ft
Date started: 10-22-62
Date completed: 10-23-62

Boring method: Hollow auger
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material
8.0	PLEISTOCENE SERIES Clay, silty to silt, clayey, brown mottled with gray; local wash
13.0	Silt, brown; grades to sandy silt
32.5	Till - clay, silty, gray; trace sand and gravel; few cobbles; gravel seams
34.0	*
44.0	Till - clay, silty, sandy, gray; gravel seams
54.0	Till - clay, silty, cobbly, gray
68.5	Till - clay, gray, wet
69.1	**
	Bottom of hole at 69.1 feet

Samples						
No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
1	2S	2.0- 3.5	15	11	1.6	28.2
2	2S	4.5- 6.0	9	9		21.1
3	2S	7.0- 8.5	13	11		
4	2S	9.5-11.0	12	12		
5	2S	12.0-13.5	8	17		
6	2S	14.5-16.0	13	17	2.8	14.9
7	2S	17.0-18.5	15	43	1.4	14.5
8	2S	19.5-21.0	18	20	3.8	14.3
9	2S	22.0-23.5	18	28	4.4	15.4
10	2S	24.5-26.0	18	21	3.1	16.6
11	2S	27.0-28.5	18	21	3.0	18.4
12	2S	29.5-31.0	18	22	3.8	13.5
13	2S	32.0-33.5	9	16		
14	2S	34.5-36.0	18	20		
15	2S	37.0-38.5	18	38	5.2	9.4
16	2S	39.5-41.0	16	34	2.9	12.3
17	2S	42.0-43.5	2	38		
18	2S	44.5-46.0	18	25	3.3	12.3
19	2S	47.0-48.5	18	33	2.7	11.1
20	2S	49.5-51.0	18	37	3.3	12.3
21	2S	52.0-53.5	16	27	4.2	12.9

* Till - silt, clayey, sandy, gray
** Limestone fragments, tan; trace clay, silty, gray

(Continued)

BORING 3-1 (WESTON) - Continued

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
		22	2S	54.5-56.0	7	30	1.3	14.4
		23	2S	57.0-58.5	10	36	3.9	16.2
		24	2S	59.5-61.0	18	21	3.8	17.5
		25	2S	62.0-63.5	18	48	1.6	18.2
		26	2S	64.5-66.0	18	14	2.1	17.6
		27	2S	67.0-68.5	12	47	0.8	19.4
		28	2S	69.0-69.1	1	100/1"		

BORING 3-2 (WESTON)

Boring 3-2, NW SW sec. 35, T. 39 N., R. 8 E. Elevation 780 feet. Drilled by Layne-Western in 1951. Sample set 20940 studied by P. M. Busch, May 1951.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
WISCONSINAN STAGE	
Till, calcareous, very silty, dark yellowish orange	5
Till, calcareous, clayey, dark yellowish orange to yellowish gray	15
Till, calcareous, gravelly at base, dark yellowish gray	85
Gravel, fine, a little sand, yellowish gray	100
SILURIAN SYSTEM	
NIAGARAN SERIES	
BRANDONBRIDGE FORMATION	
Dolomite, argillaceous, fine to medium, gray	110

BORING 3-3 (WESTON)

Boring 3-3, SW SE sec. 26, T. 39 N., R. 8 E. Elevation 779 feet. Drilled by Neely and Schimelpfenig in 1940.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow	30
Clay, gray	88
Sand	92
SILURIAN SYSTEM	
Niagaran lime (dolomite)	145

BORING 3-4 (WESTON)

Boring 3-4, SE NE sec. 19, T. 39 N., R. 9 E. Elevation 745 feet.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Gravel and clay, blue	70
SILURIAN SYSTEM	
Rock	71

BORING 3-6 (WESTON)

Boring 3-6, NW SE sec. 16, T. 39 N., R. 9 E. Elevation 720 feet. Drilled by Meadow Equipment in December 1963.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow, and gravel	19
Clay, blue	28
Gravel	42
Clay, blue	68
Gravel and sand	78
SILURIAN SYSTEM	
Limestone	115

BORING 3-7 (WESTON)

Boring 3-7, SW NW sec. 15, T. 39 N., R. 9 E. Elevation 720 feet. Drilled by C. C. Diebold in 1947.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay, yellow	15
Clay, blue	45
Sand and clay	55
Clay, blue	105
Hardpan	114
SILURIAN SYSTEM	
Limestone	133

BORING 3-8 (WESTON)

Boring 3-8, NW NW sec. 15, T. 39 N., R. 9 E. Elevation 746 feet. Drilled by Wehling Well Works in March 1960. Sample set 35227 studied by Frank J. Wobber, September 1960.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Soil, black, clayey	5
Till, calcareous, clayey, sandy, yellow-buff, brown	10
Clay, few pebbles, buff to yellow-buff	15
Sand, clay, very fine to medium, incoherent, subangular to subrounded, multicolored	20
Till, calcareous to dolomitic, very pebbly, gray to buff-brown	95
Gravel, clay, angular to subrounded, multicolored	100
SILURIAN SYSTEM	
NIAGARAN SERIES	
JOLIET FORMATION	
Dolomite, partly silty, partly trace to a little glauconite, very fine to finely crystalline, compact to partly vesicular, a little sugary, buff-gray to white, a little greenish gray to white, partly speckled gray to dark gray	160

BORING 4-1 (ARGONNE), SE NE sec. 9, T. 37 N., R. 10 E.

Surface elevation: 732 ft
Date started: 1-7-63
Date completed: 1-10-63

Boring method: Hollow auger (0-129 ft)
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material	Samples No.	Type	Depth (ft)	Recovery (in.)	Blows/18" drop hammer	Q_u	MC
1.5	* Black topsoil							
	Silt, clayey, brown, mottled with gray and yellow; trace of sand and gravel; cobbly	1	2S	2.0- 3.5	16	49	5.2	18.0
6.5		2	2S	4.5- 6.0	14	43	4.5+	14.2
	Till - clay, silty, brown; trace of gravel	3	2S	7.0- 8.5	18	78	5.2	13.9
14.0		4	2S	9.5-11.0	18	41	5.2	16.7
	Till - clay, silty, gray; trace of sand, pebbly and cobbly; sand and silt seams below 29 feet	5	2S	12.0-13.5	18	46	5.2	
		6	2S	14.5-16.0	16	48	5.2	15.4
		7	2S	17.0-18.5	17	40	4.3	14.0
		8	2S	19.5-21.0	18	32	5.2	14.5
		9	2S	22.0-23.5	18	23	5.2	12.4
		10	2S	24.5-26.0	18	27	3.2	13.9
		11	2S	27.0-28.5	18	148	4.8	16.9
		12	2S	29.5-31.0	18	25	3.7	15.8
43.5		13	2S	32.0-33.5	16	51	5.2+	14.5
	Till - clay, silty, gray; trace of sand and gravel; a few cobbles	14	2S	34.5-36.0	17	32	4.1	15.9
		15	2S	37.0-38.5	16	48	5.2	13.8
52.5		16	2S	39.5-41.0	8	56	5.2	15.7
	Gravel, sandy, brown, coarse, bouldery, dry	17	2S	42.0-43.5	18	43	2.7	16.8
		18	2S	44.5-46.0	8	54		14.5
		19	2S	47.1-48.5	18	50	4.9	16.4
		20	2S	49.5-51.0	18	51	3.6	14.7
72.5		21	2S	52.0-53.5	11	150/11"		

* PLEISTOCENE SERIES

(Continued)

BORING 4-1 (ARGONNE) - Continued

Depth (1"=10')	Description of material
78.0	Gravel, sandy, brown, fine to medium
103.0	Sand, gravelly, brown
108.0	Sand, silty, gray-brown; a few cobbles
111.5	Till - clay, sandy, gray; trace of gravel
124.0	Till - silt, sandy, light gray; trace of clay; some limestone fragments
126.0	Broken rock (limestone)
129.0	SILURIAN SYSTEM Bedrock

Samples						
No.	Type	Depth (ft)	*Recovery (in.)	Blows/18" drop hammer	Q_u	MC
22	2S	54.5- 56.0	9	150/ 9"		
23	2S	59.5- 61.0	10	267/12"		
24	SS	62.0- 62.5	4	201/ 6"		
25	2S	62.5- 63.5	6	295/ 6"		
26	SS	63.5- 64.0	5	252/ 6"		
27	SS	68.0- 69.5	10	77		
28	SS	73.0- 74.5	10	48		
29	SS	79.5- 81.0	7	69		
30	SS	84.5- 86.0	7	60		
31	SS	89.5- 91.0	8	60		
32	SS	94.5- 96.0	2	57		
33	SS	99.5-101.0	2	62		
34	SS	104.5-106.0	9	51		
35	SS	109.5-111.0	10	29	2.5	11.6
36	SS	112.0-113.5	9	220/13"	4.5+	9.3
37	SS	114.5-115.0	0	200/ 3"		
38	SS	117.0-118.5	12	109		8.9
39	SS	119.5-121.0	12	160	5.5	6.8
40	SS	122.0-123.0	10	300/11"	4.5+	7.3
41	SS	124.0		Refusal		

BORING 4-2 (ARGONNE)

Boring 4-2, NW NE sec. 12, T. 37 N., R. 9 E. Elevation 662 feet. Drilled by Gray-Hartong.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Drift	65 +
SILURIAN SYSTEM	
Limestone (much broken rock)	100 ±

BORING 4-3 (ARGONNE)

Boring 4-3, SE SW sec. 7, T. 37 N., R. 10 E. Elevation 661 feet. Drilled by Gray (Breitzke) in 1934.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Drift	38
SILURIAN SYSTEM	
Limestone	78

BORING 4-4 (ARGONNE)

Boring 4-4, NW sec. 17, T. 37 N., R. 10 E. Drilled by William Breitzke in 1954.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Dirt, black	2
Clay, yellow	14
Clay, blue	27
Sand and gravel	35
Clay, blue	45
Sand and gravel	51
SILURIAN SYSTEM	
Rock	53

BORING 4-5 (ARGONNE)

Boring 4-5, SE SW sec. 14, T. 37 N., R. 10 E. Elevation 704 feet. Drilled by Jack Hinton and Son in 1962.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Dirt, black	2
Clay, yellow	8
Sand, fine, silt and water	36
Gravel, hard, cemented	87
SILURIAN SYSTEM	
Lime, broken, brown	102
Lime, light brown	175
Lime, gray, and water	185
Lime, blue-gray	208
Shale, green	225

BORING 5-1 (JOLIET ARSENAL)

Boring 5-1, NE NE sec. 10, T. 43 N., R. 9 E. Elevation 573 feet. Drilled by Layne-Western in 1958. Sample set 31345 studied by G. H. Emrich, February 1959.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till, gravelly, yellowish buff, oxidized, leached	10
Gravel, coarse; a little till, sandy, yellowish buff, oxidized, partly leached	21
ORDOVICIAN SYSTEM	
CINCINNATIAN SERIES	
MAQUOKETA FORMATION	
Dolomite, fine to medium, a little coarse, crystalline, slightly speckled (brown, black), white to light gray	31

BORING 5-2 (JOLIET ARSENAL)

Boring 5-2, SW SE sec. 13, T. 34 N., R. 9 E. Elevation 610 feet. Drilled by Fisher.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Clay	33
ORDOVICIAN SYSTEM	
Limestone	79

BORING 5-3 (JOLIET ARSENAL)

Boring 5-3, NE NW sec. 29, T. 34 N., R. 10 E. Elevation 645 feet. Drilled by S. B. Geiger and Co. in 1942. Sample set 7997.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Drift	65
ORDOVICIAN SYSTEM	
Dolomite, silty, fine, light gray	85

BORING 5-4 (JOLIET ARSENAL)

Boring 5-4, NE NW sec. 32, T. 34 N., R. 10 E. Elevation 630 feet. Drilled by Schorie and Dreher, December 1940. Sample set 5514 studied by L. E. Workman and M. H. Smith, June 14, 1941.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till, silty, calcareous, brownish gray, yellowish buff	15
Till and clay, white, weak	17
SILURIAN SYSTEM	
JOLIET FORMATION	
Dolomite, very fine, gray	25

BORING 5-5 (JOLIET ARSENAL)

Boring 5-5, NE NE sec. 16, T. 33 N., R. 10 E. Elevation 642 feet. Drilled by S. B. Geiger and Co. in 1941. Sample set 6356 studied by M. H. Smith, August 20, 1941.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till, calcareous, yellow	5
Till, calcareous, gray to brownish gray	50
SILURIAN SYSTEM	
NIAGARAN SERIES	
JOLIET DOLOMITE	
Dolomite, fine, slightly vesicular, white, partly weathered yellow	52

BORING 5-6 (JOLIET ARSENAL)

Boring 5-6, NW SW sec. 15, T. 33 N., R. 10 E. Elevation 635 feet. Drilled by Fisher.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till	36
Gravel and sand	47
SILURIAN SYSTEM	
Limestone	80

BORING 5-7 (JOLIET ARSENAL)

Boring 5-7, SW SW sec. 15, T. 33 N., R. 10 E. Elevation 642 feet. Drilled by Fisher.

Description of material	Depth (ft)
PLEISTOCENE SERIES	
Till	38
SILURIAN SYSTEM	
Limestone (8")	54

BORING 5-8 (JOLIET ARSENAL), SW SW sec. 23, T. 33 N., R. 10 E.
ILLINOIS STATE HIGHWAY DEPARTMENT, BRIDGE FOUNDATION BORING LOG,
S.A.25 over F.A.I.57

Surface elevation:
Date started: 2-15-61
Date completed: 2-15-61

Boring method:
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material
1.5	*
11.0	PLEISTOCENE SERIES Till - clay-loam, brown to mottled, very stiff; trace of coarse sand
14.0	Till - clay, brown, hard; trace of coarse sand
16.0	**
18.5	x
23.5	Sand, gray, fine to coarse graded, medium dense, loosely compacted
38.0	Gravel, gray, fine graded, medium dense, some large; occasional limestone cobble
41.0	xx
44.0	+
47.0	++
	Bottom of hole at 47.0 feet

Samples						
No.	Type	Depth (ft)	Recovery (in.)	Blows/12" drop hammer	Q_u	MC
1	SS	4.5- 5.5		23	3.60	17.0
2	SS	7.0- 8.0		17	3.72	17.4
3	SS	9.5-10.5		19	2.42	19.8
4	SS	12.0-13.0		26	4.85	17.5
5	SS	14.5-15.5		13	2.05	15.7
6	SS	17.0-18.0		8		
7	SS	19.5-20.5		14		
8	SS	22.0-23.0		18		
9	SS	24.5-25.5		22		
10	SS	27.0-28.0		27		
11	SS	29.5-30.5		14		
12	SS	32.0-33.0		15		
13	SS	34.5-35.5		18		
14	SS	37.0-38.0		27		
15	SS	39.5-40.5		48		
16	SS	41.5-42.5		300		

* Topsoil, clayey, black, stiff
** Till - clay, gray, very stiff; few small pebbles
x Sand, brown-gray, fine graded, loose
xx Gravel, limestone, weathered, dense, coarse
\+ Gravel, limestone, weathered, very dense, coarse
++ Dolomite, limy, blue-gray, hard, slightly friable, earthy

BORING 5-9 (JOLIET ARSENAL), NW NW sec. 26, T. 33 N., R. 10 E.
ILLINOIS STATE HIGHWAY DEPARTMENT, BRIDGE FOUNDATION BORING LOG,
S.A.25 over F.A.I.57

Surface elevation:
Date started: 2-16-61
Date completed: 2-16-61

Boring method:
Hammer weight: 140 pounds
Hammer drop: 30 inches

Depth (1"=10')	Description of material
1.0	*
6.5	Till, clayey, loamy, brown, very stiff
9.0	Till - clay, brown, hard; few pebbles
11.5	**
17.5	Till - clay, gray, very stiff; trace of coarse sand and pebbles
19.0	Silt-Loam, gray, stiff
34.0	Gravel, gray, fine graded, medium dense
38.0	x
41.0	xx
48.0	Shale, black, very dense, fissile
	Bottom of hole at 48.0 feet

Samples						
No.	Type	Depth (ft)	Recovery (in.)	Blows/12" drop hammer	Q_u	MC
1	SS	5.0- 6.0		16	2.50	17.6
2	SS	7.5- 8.5		26	6.79	16.8
3	SS	10.0-11.0		17	?	13.1
4	SS	12.5-13.5		16	2.91	14.3
5	SS	15.0-16.0		22	3.40	15.0
6	SS	17.5-18.5		18	1.94	17.5
7	SS	20.0-21.0		13		
8	SS	22.5-23.5		12		
9	SS	25.0-26.0		13		
10	SS	27.5-28.5		22		
11	SS	30.0-31.0		20		
12	SS	32.5-33.5		20		
13	SS	35.0-36.0		7	1.25	25.3
14	SS	37.5-38.5		7	1.25	
15	SS	40.0-41.0		26		
16	SS	42.5-43.5		70		
17	SS	45.0-46.0		100		
18	SS	47.0-48.0		300		

* PLEISTOCENE SERIES
Topsoil, clayey, black, stiff
** Till - clay, gray, hard; trace of coarse sand and pebbles
x Shale, black, weathered, stiff; trace of limestone sand
xx Shale, black, weathered, very stiff, loosely compacted