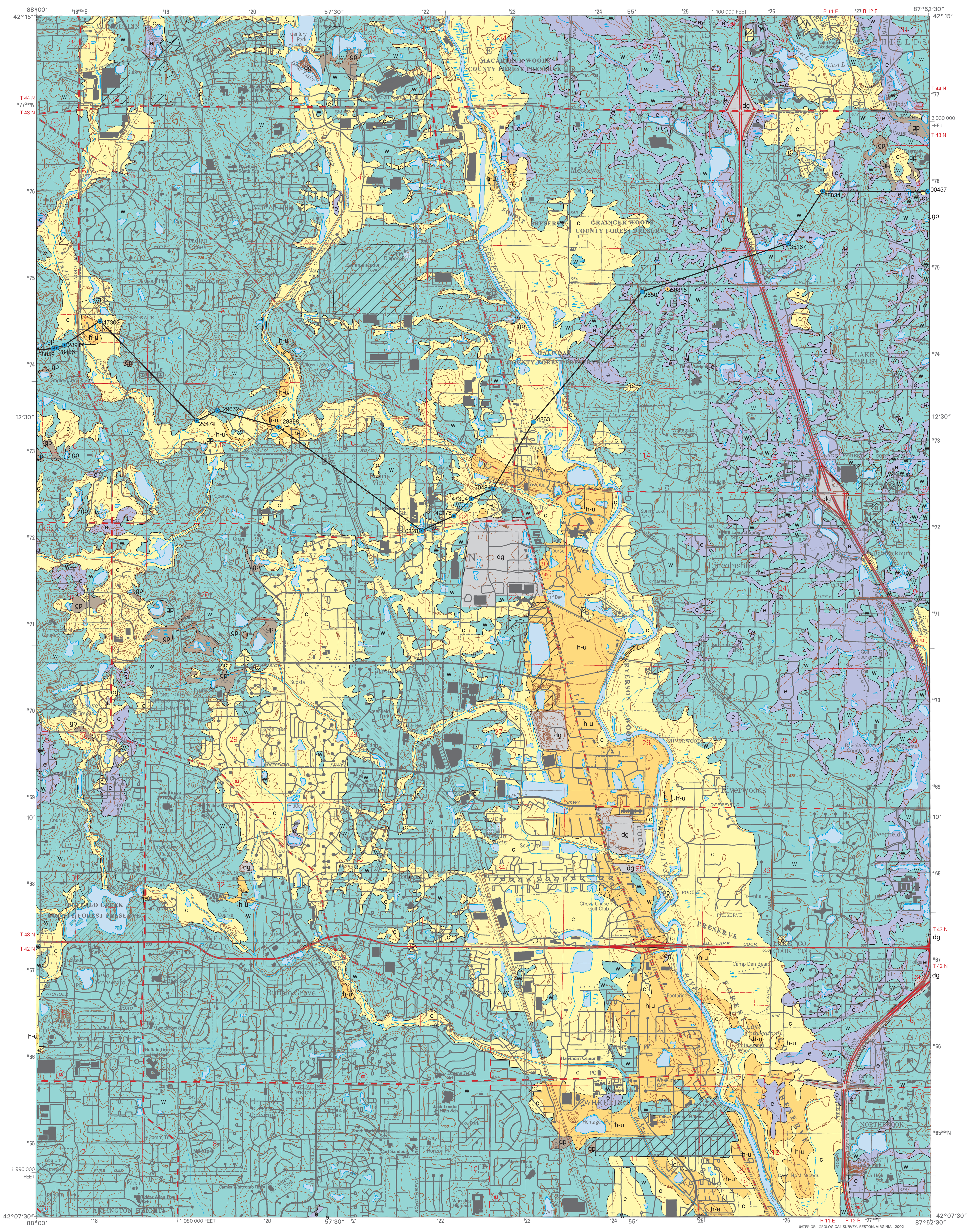
ILLINOIS STATE GEOLOGICAL SURVEY
E. Donald McKay III, Interim Director

Surficial Geology of Wheeling Quadrangle

Lake and Cook Counties, Illinois

Michael L. Barnhardt

2008



QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,000 years before present (B.P.) to today)		
Fill, compacted land, or other disturbed material; highly variable in grain size (may range from clay to gravel), and may contain construction and mining debris. Typical thickness: variable	Disturbed ground dg (present over underlying unit)	**Human-disturbed deposits** modified during construction of buildings, roads, and landfills; includes excavations in gravel pits and quarries.
Silt and clay; occasional sand lenses; trace gravel; stratified; brown to yellowish brown; loose to compact; may be mottled and gleyed; some bedding; organic-rich in places. Typical thickness: 1 to 20 feet.	Cahokia Formation (floodplain deposits) c	**Postglacial (modern) stream sediments** deposited on active floodplains; derived mainly from eroded loess and diamicton; overlies outwash sand and gravel along Des Plaines River; may overlie or interfinger with lacustrine silt and clay; includes silty slopewash deposits along footslope and minor drainageways on moraines.
Peat, muck, marl, and organic-rich sediment; may contain interbeds of silt, clay, and very fine to fine sand; black to dark brown; sediment may be gleyed and mottled; soft to firm; snail shells common. Typical thickness: 1 to 10 feet.	Grayslake Peat gp	**Organic-rich sediments** accumulated in low-lying depressions, drainageways, and on floodplains; may include small areas of open water; locally intertongued with modern alluvium, or lake sediment; commonly found around lakes and marshes and channels connecting bodies of water.
WISCONSIN EPISODE (Late) (~25,000 years - 12,000 B.P.)		
Silt and clay; massive to bedded; dark gray to light gray; calcareous; soft to hard; compact; may be sticky and plastic; very fine and fine sand common along bedding planes; occasional inclusions and lenses of light gray to white silt; some wood fragments; very few clasts; generally abrupt upper and lower contacts. Typical thickness: 5 to 25 feet.	Equality Formation e	**Postglacial and glacial proglacial lake deposits** that infill low-lying areas, or depressions in drainage channels and where water was impounded along the fronts of moraines, such as between moraines of the Lake Border Morainic System; at the surface, these sediments may interfinger with or be overlain by alluvium;
Sand and gravel; stratified; occasionally massive; yellowish to grayish brown; calcareous; loose; sand is very fine to very coarse, very well to poorly sorted; gravel is very fine to coarse, very well to very poorly sorted; trace to little amounts of silt and clay, frequently as thin beds. Typical thickness: 5 to 120 feet.	Henry Formation undifferentiated h-u	**Proglacial fluvial (outwash) sediments** exposed along the Des Plaines River floodplain and as terraces above present stream level; deposited as a valley train by meltwater along the glacier terminus.
Diamicton; silty clay loam to silty clay; dark gray to yellowish brown; massive; calcareous; compact; firm to very hard; pebbly with occasional cobbles and boulders; commonly contains silt and sand inclusions and sand and/or gravel lenses; may contain pebble-free, silty and clayey zones with strongly expressed laminations that may be interbedded with the diamicton; lenses of saturated silt and very fine sand are loose and runny. Typical thickness: 50 to 200 feet.	Wadsworth Formation w	**Subglacial and ice-marginal sediments (till)** deposited from Wadsworth glacial ice; sediment that melted out on top of the glacier or along the ice margin and was reworked by slope processes and water; laminated sequences may be more than 40 feet thick, but their areal extent is irregular and difficult to delineate.
Sand and gravel; massive or stratified; light yellowish brown to grayish brown; calcareous; sand is typically fine-grained with trace fine gravel; contains some silt beds; moderately well sorted; sometimes water-bearing. Typical thickness: 3 to 60 feet.	Henry Formation undifferentiated (cross sections only) h-u	**Proglacial fluvial (outwash) sediments** deposited in front of advancing Wadsworth glacial ice; individual beds are irregular and discontinuous; more frequent near moraine fronts. .
Silt and clay; bedded to massive; dark gray to light brown; calcareous; soft to hard; compressable when moist; compact; contains beds of very fine to fine sand; some dropstones; occasionally deformed; common abrupt upper and lower contacts. Typical thickness: 5 to 40 feet.	Equality Formation unnamed tongue (cross sections only) e	**Glacial proglacial lake deposits** that were deposited in front of Wisconsin Episode glacial ice; irregular distribution; may interfinger with sand and gravel or diamicton.
WISCONSIN EPISODE (early) (~25,000 years B.P.) to **ILLINOIS EPISODE** (~200,000 - 130,000 years B.P.)		
Sand, gravel, diamicton, and silt; pebbly to cobbly sandy loam to silty clay loam; light reddish brown to grayish brown; calcareous; composite unit quite variable in texture and character; compact; hard to extremely hard; silt is massive to crudely stratified with some pebbles; sand and gravel is mostly composed of dolomite clasts with some igneous pebbles and cobbles. Typical thickness: 5 to 25 feet.	Older sediment undifferentiated (cross sections only) os	**Stratified glacial lake sediments, older diamicton and outwash, and weathered bedrock** widespread but variable thickness and texture makes it difficult to differentiate sediment type using drillers' descriptions

PRE-QUATERNARY DEPOSITS

Description	Unit	Interpretation
SILURIAN PERIOD (~443 to 416 million years B.P.)		
Rock; predominantly dolomite overlain locally by shale; upper surface is commonly fractured with crevices and solution cavities; some oil staining	Bedrock (cross sections only)	**Bedrock** associated with shallow marine environment of Silurian Period; buried by ~120–250 feet of Quaternary sediments

Data Type

- Stratigraphic boring
- Water well boring
- 26211 Dot indicates boring is to bedrock.
- Contact
- A — A' Line of cross section

Note: The county number is a portion of the 12-digit API number on file at the ISGS Geological Records Unit. Most well and boring records are available online from the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data (500dpi DRG) provided by the United States Geological Survey. Topography compiled 1988. Planimetry derived from imagery taken 1998 and other sources. Public Land Survey System and survey control current as of 1992. Boundaries current as of 2002.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, east zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

SCALE 1:24,000
1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

BASE MAP CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2008

Geology based on field work by Michael L. Barnhardt and Jason F. Thomason.

Digital cartography by Jennifer E. Carrell and Jane E.J. Domier, Illinois State Geological Survey.

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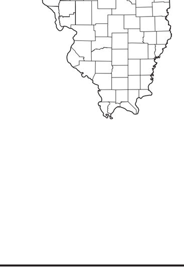
Illinois State Geological Survey

For more information contact:
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu



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4		5
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ADJOINING QUADRANGLES
1 Grayslake
2 Libertyville
3 Waukegan
4 Lake Zurich
5 Highland Park
6 Palatine
7 Arlington Heights
8 Park Ridge

APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route
U.S. Route
State Route

Introduction

Most of the counties in northeastern Illinois are among the most rapidly growing areas of population in the state and some communities are among the most rapidly growing in the country. Although some of this region draws the majority of its drinking water from Lake Michigan, a significant portion, including most of the rapidly-growing areas, relies upon groundwater from Quaternary sand and gravel deposits or from shallow bedrock.

The Illinois State Geological Survey (ISGS) has implemented a mapping program to develop three-dimensional maps of the glacial geology from land surface to the top of bedrock. Funding for mapping the surficial geology of the Wheeling Quadrangle was provided in part by a grant from the USGS National Cooperative Geologic Mapping Program (STATEMAP). These funds were used to develop the detailed map of the surficial geology, the cross section, and the extensive database that is required to accomplish the planned three-dimensional mapping, which is funded by a separate cooperative agreement with the USGS Central Great Lakes Geologic Mapping Coalition (CGLGMC) and additional funding from the General Revenue Fund of the State of Illinois. Map and digital products that will be developed include three-dimensional models of the material (sediment) and aquifer-bearing units, and maps of the surficial geology, aquifer conductivity, aquifer sensitivity, recharge, aquifer geometry, and susceptibility to contamination. These maps and products can be used by county and municipal agencies and the public for a variety of projects including water utilization, land use, and transportation network planning, and open space and environmental issues.

Regional Setting and Geomorphology

The surficial geology of the Wheeling Quadrangle developed predominantly as a result of continental glaciers and their meltwater during the last glaciation (Wisconsin Episode). While the thickness of glacial sediments in Lake County ranges from about 120 to 350 feet, the Quaternary deposits in the Wheeling Quadrangle are generally less than 200 feet thick. These sediments were deposited during at least three major glacial advances that occurred between about 25,000 and 14,000 years ago (Wisconsin Episode) and a fourth (and possibly more) that occurred between about 200,000 and 130,000 years ago (Illinois Episode) (fig. 1).

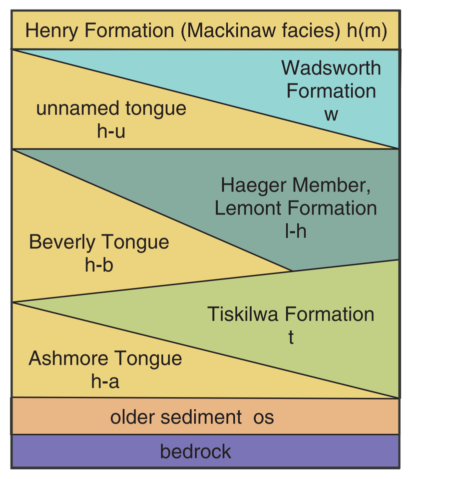

Figure 1 Intertonguing between Henry Formation outwash (gold) and Wisconsin episode till units (green). Older sediment may be early Wisconsin or older. After Hansel and Johnson 1996.

Interpreting the shape (geomorphology) of the landscape is important to understanding the late Quaternary glacial history of the study area. On numerous occasions, glaciers fluctuated into and out of the Lake Michigan basin. Their former margins are preserved on the landscape commonly as arcuate ridges (moraines) (fig.2). These boundaries help delimit the interpretations of the stratigraphy and depositional environments associated with them (Thomason and Barnhardt 2007). Parts of the Valparaiso Morainic System, the Tinley Moraine, and the Lake Border Morainic System are mapped on the Wheeling Quadrangle. Several of these moraines abut and overlap on the Libertyville Quadrangle, immediately north of the Wheeling Quadrangle where three (Park Ridge, Deerfield, and Blodgett) of the four Lake Border moraines are present (Barnhardt 2005). The Lake Border moraines are generally well-defined with proximal and distal slopes that are steeper and, therefore, easier to delineate than those of the Valparaiso and Tinley moraines in this area.

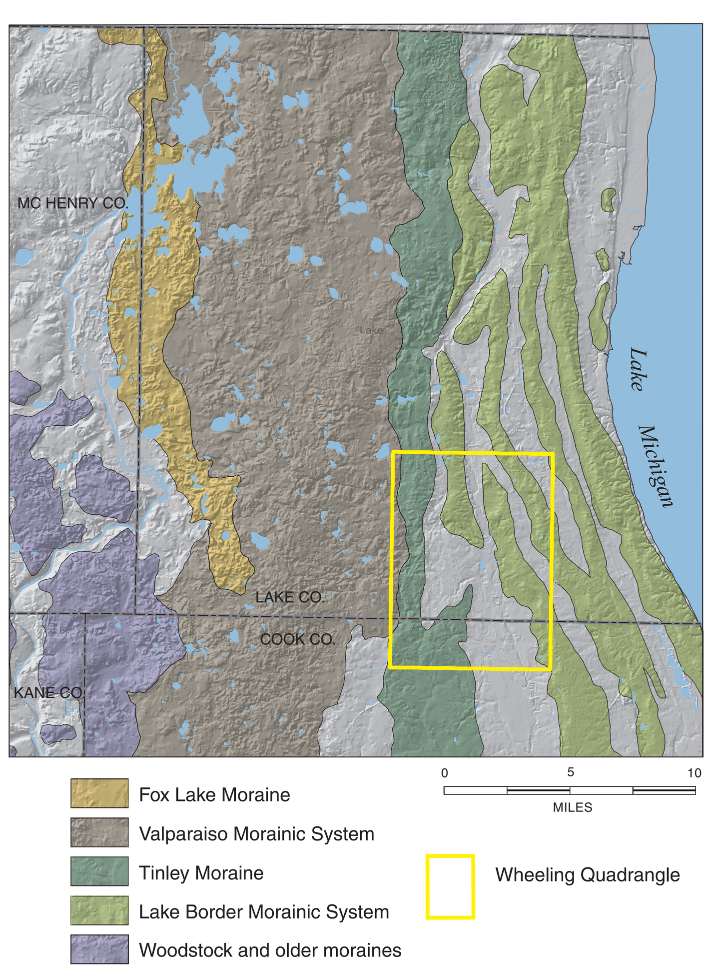

Figure 2 Surface topography and moraines of northeastern Illinois. After Willman and Frye 1970; Willman and Lineback 1970.

On the Wheeling Quadrangle, a moraine associated with the Valparaiso Morainic System is found along the western-most edge of the mapping area, where the highest elevations and thickest accumulations of glacial sediments are found. The Tinley Moraine abuts and may on-lap the Valparaiso moraine. The Park Ridge Moraine occurs immediately to the east of the Tinley Moraine and is found on both sides of the Des Plaines River. (fig. 3). Bretz (1939a, 1939b, 1943, 1955) mapped this moraine as Tinley ground moraine but Willman and Frye (1970), Willman and Lineback (1970), Barnhardt (2005), and this report map this moraine as the Park Ridge. Recent high resolution LiDAR-based digital elevation models and associated shaded relief visualizations help delineate the Lake Border moraines in this area, even though these moraines are fragmented and breached by the Des Plaines River in several places (figs. 2 and 3). The Deerfield Moraine traverses the northeast corner of the Wheeling Quadrangle.

Unit Characterization and Stratigraphy

Several lithologically distinct diamictons, silt and clay beds, and sand and gravel units were deposited by the Lake Michigan lobe in northeast Illinois (fig. 1). The majority of the diamicton (a massive to poorly sorted mixture of clay, silt, sand, and gravel) found in this quadrangle is Wadsworth till and it comprises most of the volume of each of the moraines (fig. 2 and cross section). Locally, glacial meltwater deposits (predominantly sand and/or gravel) and lake deposits (silt and very fine sand with interbedded clay and sand) are present within and between the tills and are classified as tongues of the Henry and Equality Formations, respectively (Hansel and Johnson 1996). These formations are mapped in the subsurface where evidence of lateral continuity is found in adjacent boreholes. In the Wheeling Quadrangle, this most often occurs in the western part where the Valpariaso and Tinley moraines are mapped. In many areas to the east, however, layered, thin, discontinuous beds and lenses of sand, silt, and clay are found throughout the diamicton, especially the Wadsworth. These layers may represent ice-contact sediments deposited in fluvial and lacustrine environments that were ephemeral and very local in extent. These layers are not connected in the cross section because they are difficult to trace even between closely spaced boreholes. In addition, an undifferentiated highly variable deposit of early Wisconsin or Illinois Episode-age sediment (composed of sand and gravel, silt, diamicton, and/or weathered dolomite) directly overlies bedrock throughout much of the quadrangle, but appears to be discontinuous (see cross section, os). A similar, and probably correlative, unit is found throughout Lake and adjacent McHenry, Kane, and Cook counties (Barnhardt 2005, Barnhardt et. al 2001, Hansel 2005, Thomason and Barnhardt 2007 and 2008). In those areas, depending on its texture, color, and other characteristics, this unit may be identified as Peddicord, Ashmore, Tiskilwa, or undifferentiated Glasford. In the absence of high quality core samples to examine, this unit is difficult to identify.

The Quaternary deposits in the mapping area overlie directly dolomitic bedrock of Silurian age. The uppermost part of this bedrock may be shaly, highly fractured, vugy, and, locally, oil-stained. It exhibits an eastward regional slope but over small areas tends to be rather flat.

The unit identified as older sediment (os) is frequently found in the mapping area but is probably not continuous in distribution. It is variable in texture, color, and density but most often is a grayish-brown, gritty, dense, very hard loam to silt loam diamicton. It may be mapped as the lower part of the Tiskilwa diamicton in some areas of Lake County. It is mapped only in cross section.

Tiskilwa diamicton occurs sporadically in the subsurface across the quadrangle but it is not identified in the cross section presented in this report. This diamicton commonly displays a distinctive reddish-brown color and loamy texture but may include thick beds of pebble-free clay and silt, most likely deposited in a lacustrine environment. It most likely occurs toward the western part of the quadrangle where it comprises part of the Valparaiso and Tinley moraines.

The Haeger diamicton also is found infrequently in this area. In some places it may exhibit a reddish color where the glacier incorporated Tiskilwa diamicton and redeposited it. The upper surfaces of the Haeger and Tiskilwa diamictons are interpreted to be erosion surfaces. The Haeger is often similar in texture to vertically-adjacent sand and gravel deposits of the Henry Formation that contain beds of silt and gravel. The Haeger diamicton does not occur at land surface on the Wheeling Quadrangle and it is not encountered on the cross section, even though it most likely occurs along the western edges of this map.

The Wadsworth diamicton, the only till exposed at land surface in the Wheeling Quadrangle, is predominantly a dark grayish brown, silty clay to silty clay loam diamicton that also contains lenses and thick beds of sorted sediment, especially silty clay, silt, and fine sand. Near a moraine front, the Wadsworth diamicton exhibits a coarser texture and an increase in the number and thickness of lenses and beds of sand and/or gravel (see cross section, w and h-u). The more uniform diamicton likely was deposited subglacially, whereas the more variable (bedded and coarser) diamicton may represent material that melted out near the ice margin or on top of the glacier and was reworked by slope processes and water.

As the Wadsworth ice was generally melting back toward the Lake Michigan basin, several moraines formed at ice margins (see cross section and figures 2 and 3). Locally, sediments of the Valparaiso Morainic System are present along the western margin of the quadrangle, This moraine forms a hummocky, upland surface west of the Wheeling Quadrangle. Immediately to the east of the Valparaiso Morainic System lies the Tinley Moraine. The Tinley Moraine represents a readvance of the ice margin, based on the presence of proglacial sorted sediment (outwash sand and gravel), and laminated silt and clay (lake sediment) regionally found between the Wadsworth till of the Tinley Moraine and Wadsworth till in the subsurface (on cross section see Tinley Moraine segment, h-u). North-south trending ridges of the Lake Border Morainic System are present in the central and eastern part of the quadrangle. These moraines likely formed during short-lived readvances or still-stands of the retreating glacier. In the central part of the quadrangle, the Lake Border moraines (Park Ridge and Deerfield) are dissected by the Des Plaines River and its tributaries (Willman and Lineback 1970, Willman 1971). South of this area, the Des Plaines River carried glacial meltwater between the Tinley and Lake Border moraines toward glacial Lake Chicago, which had an outlet through the Tinley and Valparaiso moraines west of Chicago.

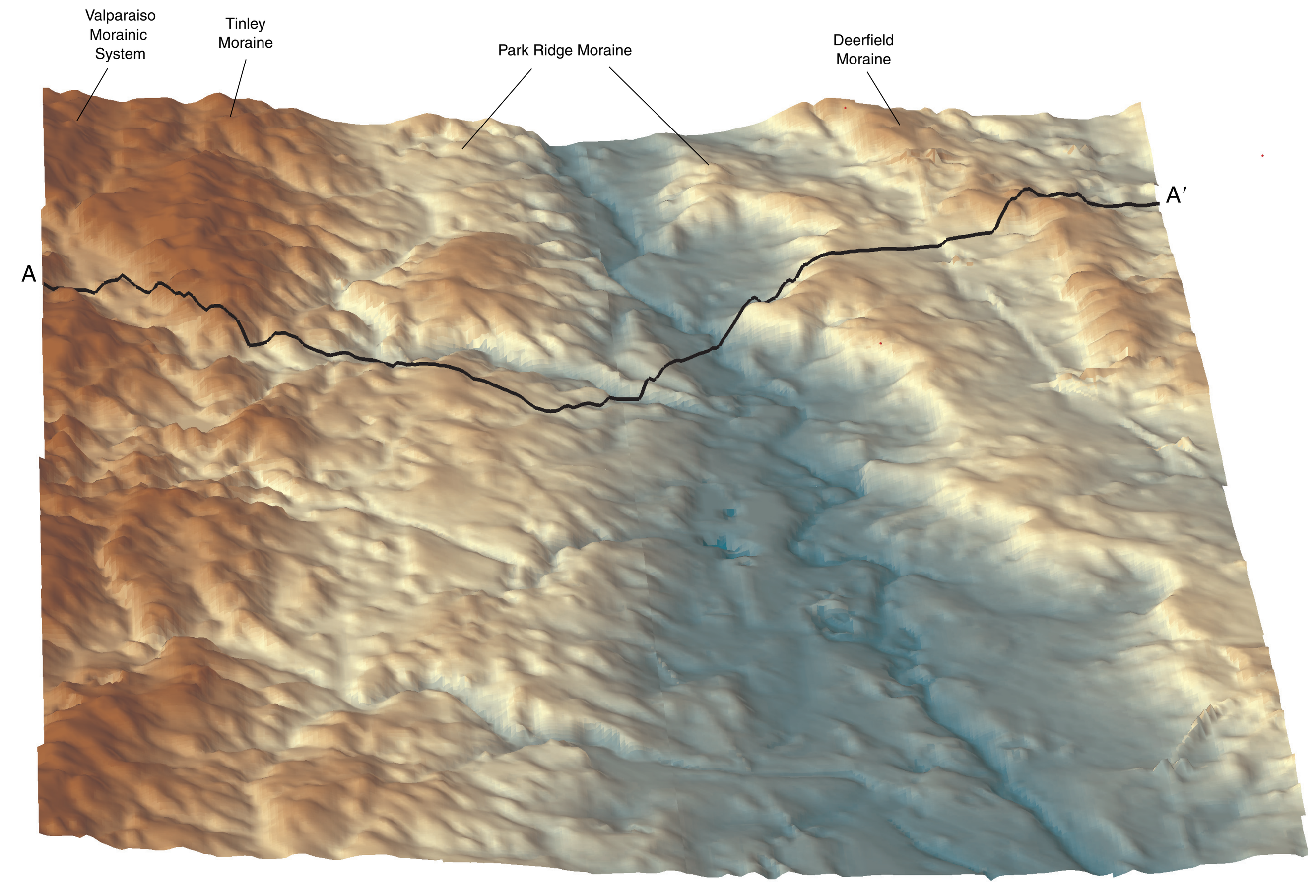

Figure 3 Surface topography of Wheeling Quadrangle with cross section A–A′. Digital elevation model generated from 30-m USGS DEM.

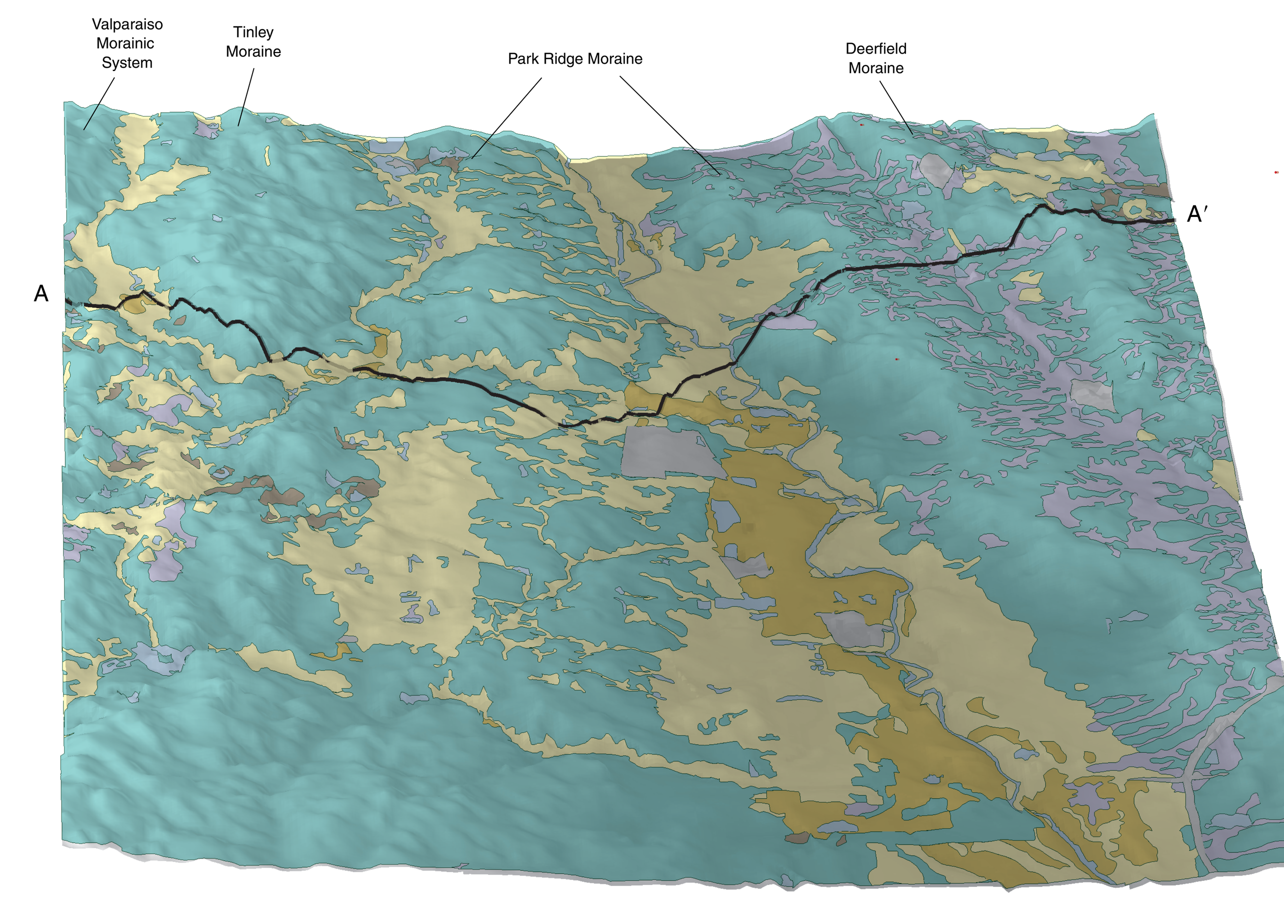

Figure 4 Surficial geology over topography of Wheeling Quadrangle.

The Wadsworth Formation ranges from about 100 to 200 feet in thickness, with the thicker accumulations occurring near moraine fronts. Along the Des Plaines River and its tributaries, the Wadsworth Formation is overlain by outwash (Henry Formation) and modern stream sediment (Cahokia Formation). Locally, fine-grained lake sediment (Equality Formation) and muck or peat (Grayslake Peat) occurs in depressions in both upland and floodplain locations. An extensive area of lake sediment occurs between the Lake Border moraines and probably represents an area where meltwater was impounded during their formation (figs. 3 and 4).

Mapping Techniques

The map of surficial geology is based largely on digitized soils maps (scale 1:15,840) from the Soil Survey of Lake County, Illinois (Paschke and Alexander 1970, U.S. Department of Agriculture 2004). Initially, individual soil series were grouped by their parent material following (1) the classification key in Soils of Illinois (Fehrenbacher et al. 1984), (2) profile descriptions in the survey report, (3) NRCS field notes, (4) discussions with NRCS soil mappers, and (5) updated individual Soil Series Description sheets acquired either directly from the USDA-NRCS or downloaded from their web site. These parent material classes then were grouped into more general geologic material classes comprising the mapping units used for this map, following Hansel and Johnson (1996) and Willman and Frye (1970).

The parent material (geologic material) classes were generalized for the surficial geology map because the soil-based data layer created a very complex map with polygons that were too small for incorporation into cross sections. It is assumed the thickness of each surficial unit is at least 6 to 10 feet or more based upon the depth to which soil mappers sample during their mapping. The thickness of specific units was adjusted where our drilling, field observations, or records suggested otherwise. Selected soil series, or in some cases individual polygons in various soil series, were regrouped into different geologic material classes following extensive fieldwork and data analysis for the Wheeling and other quadrangles in Lake County (Barnhardt 2005, Barnhardt et al. 2001, Stumpf 2004, Hansel 2005, Thomason and Barnhardt 2007 and 2008). The sediment at land surface (parent material for the soils) was examined and correlated with its geomorphic (landscape) position to develop a sediment-landscape model. This model was used to interpret the sediment description for every water well, stratigraphic, or engineering boring used in the mapping.

Two boreholes were drilled to bedrock and continuously sampled using the ISGS CME-75 drill rig to acquire high quality samples using a wireline sampler. Natural gamma logs were collected for each. The cores from these two boreholes were described in detail in conjunction with their gamma logs to better understand and interpret the descriptive records from adjacent water wells. Geologic information for subsurface units depicted on the cross section was obtained from core descriptions for the above-mentioned boreholes and sample sets obtained from water wells and engineering boreholes, which are available in databases at the ISGS. A total of 1461 water well and engineering boreholes are located on the quadrangle of which the locations of 1078 were verified to tax parcel size and repositioned as needed (fig. 5). The quality of the geologic information was evaluated when individual boreholes were selected for developing and validating the surficial geology map and cross section. The legend of map units provides additional discussion on the variability of sediments and their occurrence on the landscape.

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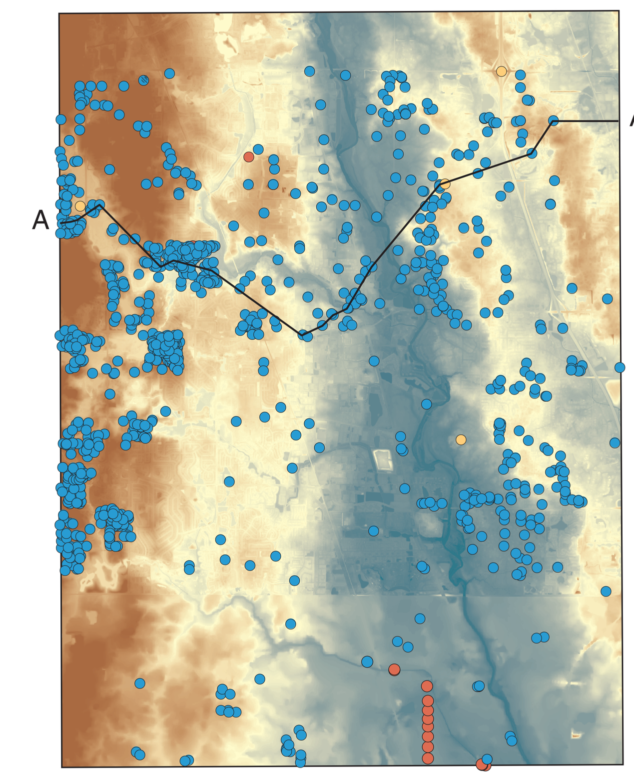

Figure 5 Locations of boreholes and cross section. Red circles are engineering boreholes; blue are water wells; and yellow are stratigraphic.

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