Central Great Lakes Geologic Mapping Coalition contract report
CGLGMC Fox Lake-SG

Surficial Geology of Fox Lake Quadrangle

McHenry and Lake Counties, Illinois, and Kenosha County, Wisconsin

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Introduction

The surficial geology map of the Fox Lake 7.5-minute Quadrangle (Lake and McHenry Counties, IL and Kenosha County, WI) was developed with support from the Central Great Lakes Geologic Mapping Coalition (CGLGMC) and the State of Illinois. This work is part of the Illinois State Geological Survey (ISGS) mapping program in northeastern Illinois, and its purpose is to provide preliminary geological information useful for decision-making for land use, environmental, and resource development and management. The Fox Lake Quadrangle is located predominantly in northeastern Illinois and encompasses parts of western Lake County and eastern McHenry County, and a small part of southern Kenosha County. The mapping area includes all or portions of the villages of Fox Lake, Lotus Woods, Pistakee Highlands, Spring Grove, Klondike and surrounding unicorporated areas.

The surficial geology map delineates geologic materials at the land surface, classified by their lithology (sediment type or rock type) and stratigraphy (relative position and age). The distribution of geologic materials in the study area is remarkably complex but has a mappable pattern. Thus, this map may help users with their preliminary investigations to locate water and earth resources, delineate geologically hazardous areas, or aid the construction and maintenance of transportation systems and residential and commercial infrastructure.

Quaternary Geology, Stratigraphy, and Mapping Units

The surficial geology of northeast Illinois includes a complex assemblage of glacial deposits including diamictons (mainly tills), meltwater outwash, and lacustrine deposits. Modern alluvial and lacustrine sediments are also significant in distribution and thickness, especially within the Fox River valley. Some glacial units are widely distributed throughout the area, while others are locally variable. The spatial distribution, thickness, and character of major glacial units are often dependent upon the positions of former glacier margins. In northeast Illinois, those ice margins are often indicated by moraines (fig. 1). These are commonly broad, north-south trending topographic ridges that formed along stationary ice margins during numerous glacial advances and retreats out of the Lake Michigan Basin (Hansel and Johnson 1992). Thus, major changes in the distribution and character of glacial units are most apparent in east-west trends and are also due in part to the post-glacial erosion and redistribution of sediments by the Fox River and its tributaries. These regional trends in the spatial distributions of glacial materials are complex, but it is important to conceptualize them if we are, for example, to understand properly the hydraulic character and interconnectedness of aquifer units within these glacial deposits.

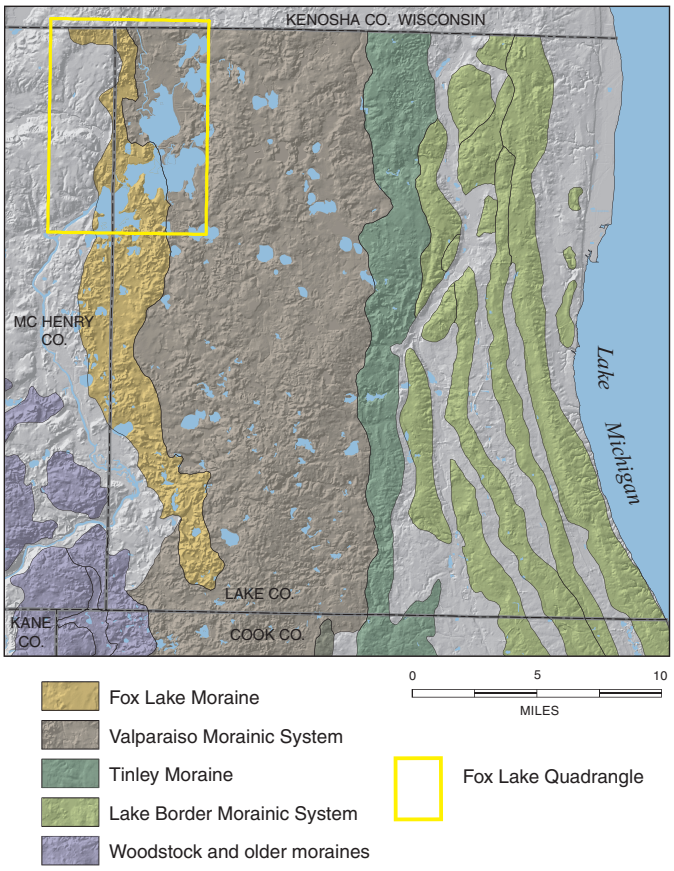

Figure 1 Regional shaded relief map with Wisconsin moraines.

Bedrock

In northeast Illinois, Silurian dolomite comprises the major rock unit at the upper bedrock surface. In the Fox Lake Quadrangle, relief on the regional bedrock surface in generally low (up to 145 feet), with bedrock elevations ranging from approximately 504–650 feet above sea level. The bedrock surface slopes generally from west to east. The highest bedrock elevations (>625 feet above sea level) are mapped in the northwest portion of the quadrangle. A subtle east-west trending bedrock valley is mapped in the southwest portion of the quadrangle. Karst topography may exist on the bedrock surface, but that interpretation is limited by data density.

Quaternary Units

Early Wisconsin sand and gravel (Ashmore Tongue, Henry Formation), lacustrine sediments (Peddicord Formation) (~24,500 years before present (BP)) and pre-Wisconsin sediments (mostly Glasford Formation diamicton and sand/gravel) (~130,000–200,000 years BP) are widely distributed in the subsurface throughout northeast Illinois. Regionally, these deposits are as much as 200 feet thick in western McHenry County and thin to the east. The lower portion contains sand and gravel facies as much as 70 feet thick locally that intertongue with diamicton facies and fill most bedrock valleys and lows. In the mapping area, the sand and gravel facies are spatially variable, often less than 50 feet thick, and commonly in contact with bedrock. The early Wisconsin Ashmore Tongue is regionally thin (<30 feet thick), but thickens locally to about 100 feet in southeastern McHenry County. Within and east of the Fox River Basin, the cumulative thickness of pre-Wisconsin deposits decreases and becomes more spatially variable. Specifically, both diamicton and sand and gravel facies of the Glasford Formation become thinner and may be locally absent. However, the Ashmore Tongue may be locally thick, especially in the northern Chain O'Lakes area near the area of Fox Lake.

The diamicton of the Tiskilwa Formation (22,500–24,500 years BP) is generally the thickest and most extensive geologic unit in northeast Illinois. In morainal deposits, the Tiskilwa unit may be locally as much as 150–200 feet thick in west-central McHenry County and north-central Kane County. In the mapping area, the topographic uplands to the west of the Fox River are cored largely by the Tiskilwa Formation and older sediments. The Tiskilwa Formation thins to the east across the Fox River, and similar to older deposits, becomes spatially variable and thin (<30 feet thick) in central Lake County. This formation also thins to the south in Kane County. Generally, the Tiskilwa till is consistently massive, dense, and clay rich. Thin, discontinuous lenses of sand and gravel are common within the unit.

The Haeger diamicton and the Beverly Tongue of the Henry Formation (sand and gravel) (15,500–16,200 years BP) are coarse-grained units that occur extensively throughout northeast Illinois but are quite variable in thickness and texture. East of the Fox River, these units are buried by the fine-grained Wadsworth Formation diamicton and its associated lake sediments. Further eastward, the Haeger diamicton and Beverly Tongue become finer grained and are thin or absent in the subsurface. In McHenry County, within the Fox River Basin and west of the river valley, these units are commonly collectively thick (as much as 150 feet) and may occur as surficial units or may be buried by thin younger outwash or modern alluvial/lacustrine sediments. The Haeger glacial advance formed the Fox Lake Moraine (fig. 1), which extends from north to south through the northern Fox River valley. In the mapping area, this moraine is thought to be associated with glacier stagnation and collapse, which created the lowlands, depressions, and lakes within the Fox River valley. A large kame delta in the northwest portion of the Fox Lake Quadrangle is also associated with the development of the Fox Lake Moraine (see geologic map). This deposit has been interpreted to be an ice-contact delta deposited when the Haeger ice margin filled the Fox River Valley (Curry et al. 1997). It is a major sand and gravel source for local aggregate producers.

The Wadsworth Formation (13,800–15,500 years BP) is an extensive surficial clay-rich geologic unit in northeast Illinois. It is characterized commonly as interstratified clayey diamicton and lacustrine sediments. In Lake County, this unit is often greater than 130 feet thick and is commonly underlain by fine-grained lacustrine deposits of silt and fine sand. However, the Wadsworth Formation thins quickly at the western edge of the county. In the Fox Lake Quadrangle, this deposit is an important confining unit for aquifers east of the Fox River.

Modern and post-glacial alluvial sediments (Cahokia Formation) and organic deposits (Grayslake Peat) (~12,500 years BP to present) fill modern river channels and wetland lowlands, respectively. These deposits are relatively thin and are often discontinuous in Lake County, but in the Fox Lake Quadrangle, these deposits are quite extensive especially within the Fox River lowlands.

Mapping Techniques

The surficial geologic map is based largely on digitized maps of updated and recorrelated soil surveys (1: 15,840 scale) for the counties of Lake (Paschke and Alexander 1970, U.S. Department of Agriculture 2004) and McHenry (Calsyn 2002). The soil survey classifications in the study area were grouped according to their parent material, and the geologic materials were then classified based on regional geologic patterns and location on the landscape. The stratigraphic nomenclature used in this map is from Willman and Frye (1970) and Hansel and Johnson (1996).

Field methods were also critical to the mapping efforts. Through an extensive drilling program by the ISGS in northeast Illinois, a total of 26 cores were collected (8 of which reached bedrock) in the area of the Fox Lake 7.5 minute Quadrangle. These cores were used as control points for interpreting a variety of other borehole information (fig. 2). Their descriptions (fig. 3) were used to establish geologic mapping units and interpret depositional environments. Many of the cores (total of 14) were collected using a

Powerprobe direct-push drill rig and reached depths of 25-60 feet. Deeper cores (total of 12) were collected using a CME 75 wire-line drill

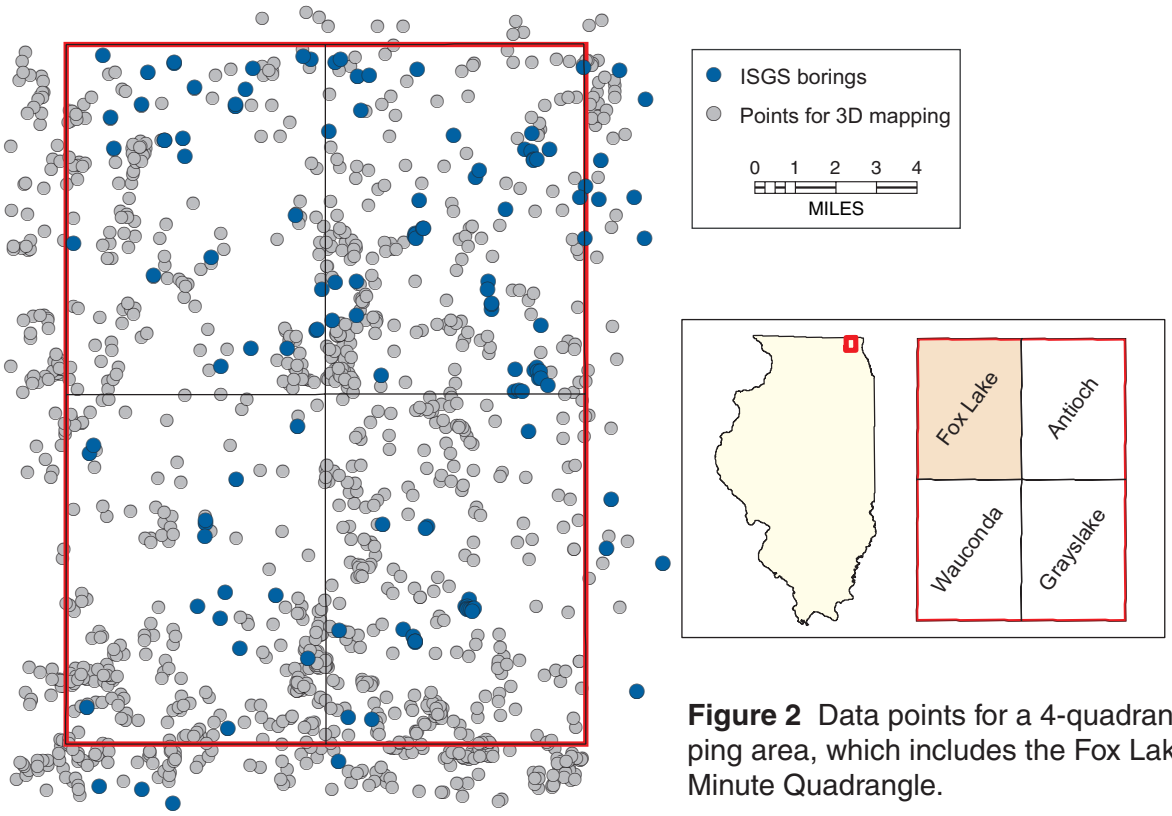

Figure 2 Data points for a 4-quadrangle mapping area, which includes the Fox Lake 7.5-Minute Quadrangle.

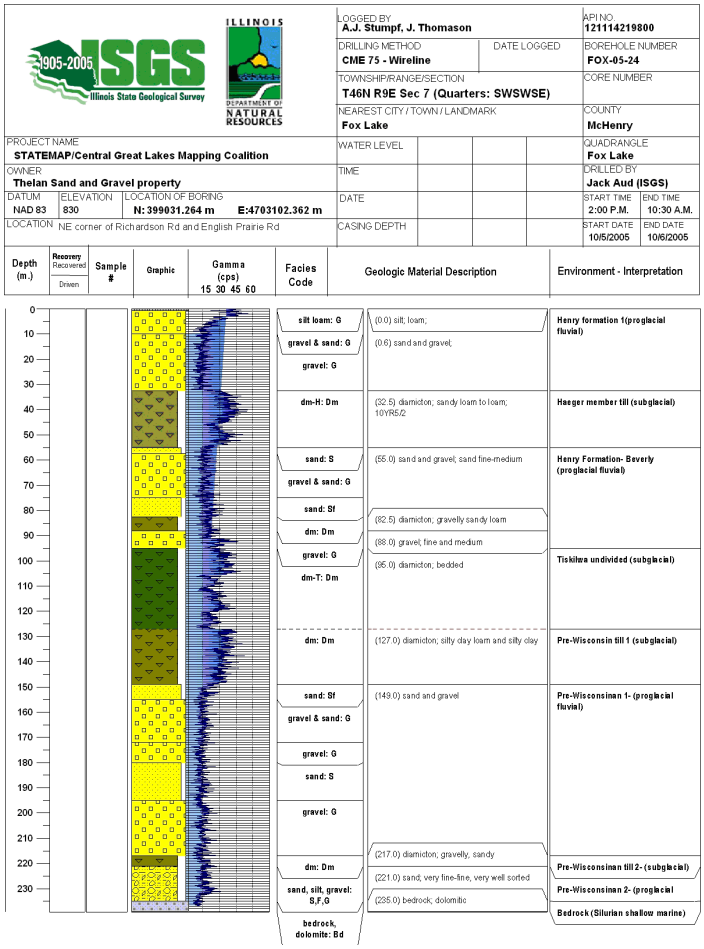

Figure 3 Stratigraphic log, gamma ray log, and descriptions of ISGS core taken from the within the area of the Fox Lake 7.5 Quadrangle. This core was used as calibration for the geophysical profiles (fig. 4).

rig, which reached depths as great as 322 feet. In addition to cores, natural gamma-ray logs were collected from each borehole to further assist in delineating geologic units (fig. 3). Monitoring wells were also installed within some boreholes to be used for long term water-level monitoring.

Surface-geophysical data were also collected in the mapping area (fig. 4). The interpretations of these data were valuable for delineating complex subsurface contacts, which were then incorporated into 3-D mapping techniques. Furthermore, outcrops of geologic materials at local sand and gravel quarries were studied and described at several locations throughout the mapping area.

Visualization techniques were used to display the sediment descriptions of water well drillers logs in three-dimensional space. The geologic materials recorded in 5060 drillers logs were standardized to 18 descriptors of unlithified material such as clay, gravel, sand, and clay and gravel mix. These standardized descriptions were then used to generate interactive 3-D datasets for display using ArcGIS software (fig. 5). This visualization of geologic data in 3-D space was critical for interpreting map units and delineating their spatial geometries and relationships. These visualizations were also valuable in 3-D mapping efforts.

Acknowledgments

We would like to thank the Lake County Forest Preserve District, Chain O'Lakes State Park, Thelan Sand and Gravel, and Payne and Dolan, Inc. for graciously allowing us to drill boreholes and install monitoring wells on their properties. Those boreholes and wells were installed by an ISGS drilling crew. We also thank numerous local land owners and municipalities for access to their property, data, and services. We are grateful to ISGS staff A. Hansel (emeritus), A. Stumpf, S. Brown, and B. Curry for helping greatly with geologic interpretations. We thank J. Carrell for map produc-

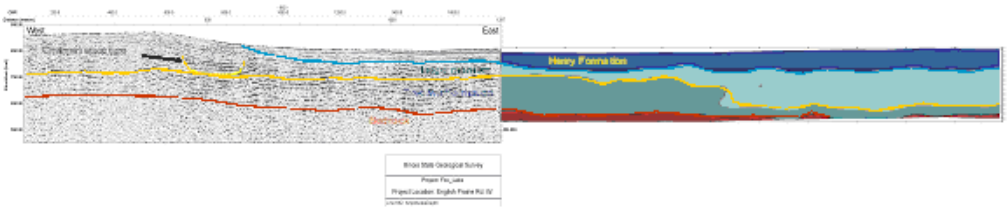

Figure 4 Combined geophysical profiles (seismic reflection and surface wave) located in the Fox Lake 7.5 minute Quadrangle (see surficial geologic map).

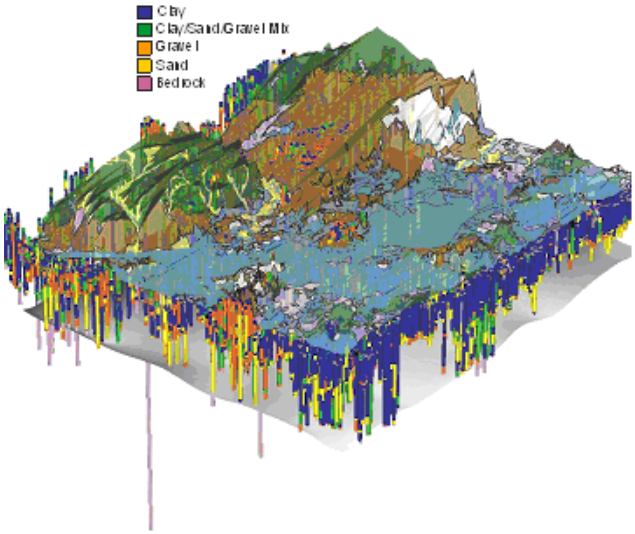

Figure 5 Three-dimensional visualization of water-well logs for the Fox Lake 7.5-minute Quadrangle. The surficial geology is shown as the surface layer and bedrock topography as the lower bounding layer. Perspective view is from the southeast. Vertical exaggeration is 50.

tion and B. Stiff and V. Amacher for data management. The GIS and Mapping Divisions of Lake and McHenry Counties provided access to digital databases. This mapping was funded by in part by the cooperative agreement between the United States Geological Survey for Three-Dimensional Mapping of the Glacial Deposits in Northeastern Illinois, Award number 04ERAG0052.

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