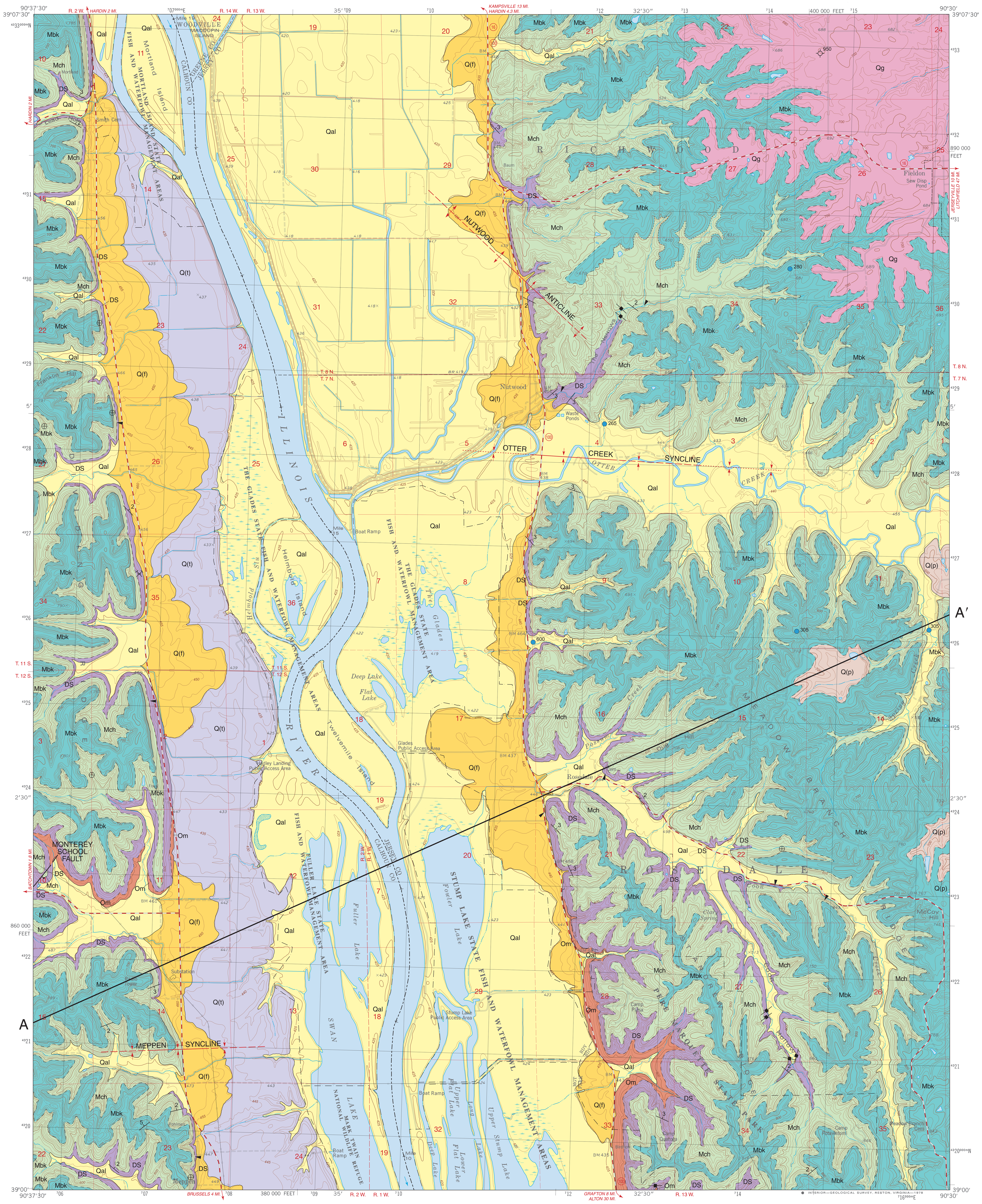
ILLINOIS STATE GEOLOGICAL SURVEY
E. Donald McKay III, Interim Director

BEDROCK GEOLOGY OF NUTWOOD QUADRANGLE

CALHOUN, GREENE, AND JERSEY COUNTIES, ILLINOIS

Joseph A. Devera and Mary J. Seid
2008



EXPLANATION

Quaternary	Qal	Alluvium	Holocene
	Q(f)	Fan Deposits	
	Q(t)	Wisconsinan Stage Terrace Deposits	Pleistocene
	Q(p)	Illinoian Stage Ponded Deposits (loess covered)	
	Qg	Illinoian Stage Glasford Till (loess covered)	
		Unconformity	
Mississippian	Mbk	Burlington and Keokuk Formations	Valmeyeran
		Unconformity	
	Mch	Chouteau and Hannibal Formations	Kinderhookian
		Unconformity	
Devonian and Silurian	DS	Louisiana Limestone; Unconformity	Upper Devonian
		Cedar Valley Limestone; Unconformity	Upper Middle Devonian
		Joliet Formation; Unconformity	Niagaran
		Kankakee Formation; Unconformity; Bowling Green Formation; Unconformity	Alexandrian
Ordovician	Om	Maquoketa Formation	Cincinnatian

Symbols

- Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joints
- Abandoned quarry
- Outcrop of special note, shown where contact or map unit was well exposed at time of mapping

Drill Holes
from which subsurface data were obtained

- Water-well boring
- Dry oil well
- 109 Numeric label indicates total depth of boring in feet.

Line Symbols
dashed where inferred, dotted where concealed

- Contact
- Normal fault; bar and ball on downthrown side
- Syncline
- Anticline
- A—A′ Line of cross section

Note: Well and boring records are on file at the ISGS Geological Records Unit and are available online from the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data (Digital Line Graphs) provided by the United States Geological Survey. Topography by photogrammetric methods from aerial photographs taken 1974. DLGs created 1998.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 15

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 and 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2008

Geology based on field work by Joseph A. Devera and Mary J. Seid, 2007–2008.

Digital cartography by Jane E.J. Domier, Brendon M. Aitken, and Steve M. Radil, Illinois State Geological Survey.

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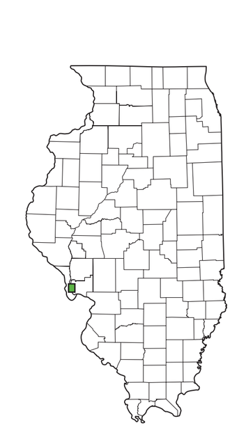


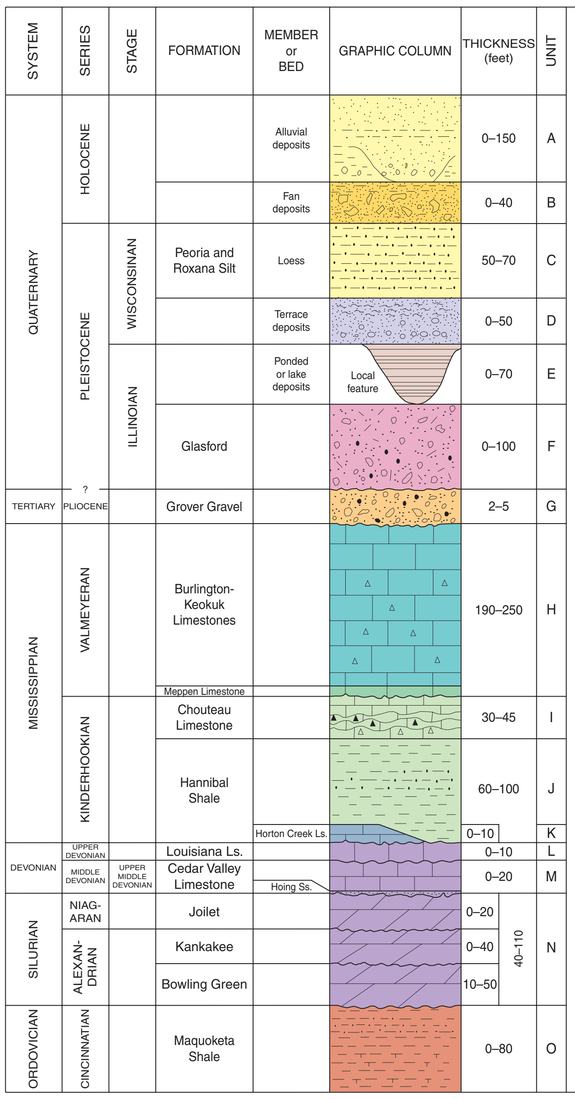
1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Hamburg
2 Hardin
3 Boyer Creek
4 Foley
5 Otterville
6 Winfield
7 Brussels
8 Grafton

MAGNETIC NORTH
TRUE NORTH
½°
APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Unimproved road
- State Route



A Alluvium Alluvial deposits. Clay, silt, sand to cobble sized boulders and rounded to angular clasts from local bedrock sources and distant sources. All sediment is confined to tributaries and creeks and major river systems.

B Fan deposits These deposits are broad sub-conical geomorphic features that occur at the mouth of creeks onto the river flood plain, alluvium. Composed of angular bedrock clasts, sand, silt and clay sized particles.

C Peoria and Roxana Silt Silt. Yellow-brown, reddish, with variable amounts of clay. The silt is windblown material that thickly mantles the bedrock close to the major river system and gradually thins away toward the east in the study area.

D Terrace deposits These deposits are composed of gravels, sand, silt and clay in the Illinois River bottoms. Geomorphic remnants of the terrace occur from about 425 to about 440 feet in elevation. The terrace deposits mainly lie along the west side of the Illinois River. The material in the feature fines upward with gravel at base to sand, silt then clay in the upper part.

E Lake deposits These deposits occur in localized areas on the east central part of the quadrangle south of Otter Creek. The sediment is composed of laminated clay and silt with gravel and sand in the lower part of the deposit. These sediments are thick and fill local ravines up to seventy feet.

F Glasford Formation Diamicton. Clay, silt, sand, gravel and boulders occur in a deposit in the northeastern corner of the map. Large clasts can be local sedimentary bedrock and rounded igneous and metamorphic erratics. Chert is also a common component. Some facies of this deposit are composed of finer grained stratified sands and clays.

G Grover Gravel Gravel. Poorly sorted gravel containing sand and clay. Clasts are composed of polished and rounded quartzite, chert, and quartz. Particles range from sand, granule and pebble size. The clasts are red, white, yellow and black. This deposit is poorly exposed and is mainly found in the alluvium in the southern part of the quadrangle. It occurs directly above the bedrock but is covered by loess.

H Burlington-Keokuk Limestones Limestone. Generally a white, crinoidal, grainstone that occurs in thin to thick beds sometimes as cross-bedded bioclastic facies. In the lower part calcite nodules are common and the limestone can be light gray, tan to brown and somewhat argillaceous. White, fossiliferous, chert nodules occurs in the middle part of the unit. Yellow dolomitic beds also occur within this unit. Brachiopods and bryozoans are also seen but are not as abundant as the disarticulated crinoid columns. The upper portion contains less chert and can be more coarsely crystalline. Unconformities bound the base and the top of this unit.

I Chouteau Limestone Limestone. A thin-bedded, dense, tan, brownish gray lime mudstone that contains small calcite nodules. Bedding is irregular to wavy and weathers to nodular surfaces. Chert is common and the formation is argillaceous to sandy in places. The lower contact is conformable but sharp.

J Hannibal Shale Shale. Gray to greenish gray, silty and can weather to sticky or gummy clay. The shale can be massive mainly non-calcareous, fissile in places and weathers to tan shale. Fossils are rare but the brachiopod *Lingula* sp., has been observed in this formation. The unit is poorly exposed but occasionally crops out and is well exposed in Coon Creek and in the Narrows of the Nutwood Quadrangle.

K Horton Creek Limestone Limestone. Gray to light gray fossil wackestone. Fragmented brachiopods, crinoids, and ramose bryozoans are common. It is thin- to medium-bedded and displays conchoidal fracture. It is sandy in places and can contain coated grains and oolites in the northern part of the study area. This unit first appears in the southwestern corner of Sec. 4, T7N, R13W, and thickens northward. It is unconformable at the base.

L Louisana Limestone Limestone. Brown-gray lime mudstone that is thin-bedded and displays conchoidal fracture. The formation is unconformable both at the base and top.

M Cedar Valley Limestone Limestone. Brown to yellow, fossil wackestone dominated by spiriferid brachiopods. Other diagnostic brachiopods include: atrypids, *Mucrospirifer* sp., *Paraspirifer* sp., *Othospirifer iowaensis*, *Ilita johnsonensis* and strophominids. Large rugose corals and articulated and disarticulated crinoid stems. Laterally, this unit can grade into fossil packstone facies. This formation is thin bedded, dolomitic, sandy in places and contains large calcite crystals. The base can be sandy and unconformable.

N Joliet, Kankakee, and Bowling Green Formations Dolomite. Yellow moldic, with a sugary appearance. Thin- to thick-bedded hard and massive. Shale is rare and thin, but is light green and occurs between beds. Glauconite occurs in the lower beds and pinkish stains are also seen in these beds. Multiple unconformities occur at the base within and on top of these dolomitic units. Fossils observed include: brachiopods, rugose corals, bryozoans, and trilobites. The trilobite Gravicalymene celebra is common in the middle to upper part of the dolomite beds.

O Maquoketa Shale Shale. Bluish gray calcareous in the lower part. The shale is predominated by claystone in the middle and silty layers in the upper part. The silty upper facies is tan-yellow and contains fossil algae. The shale weathers to gummy bluish-green clay. A dark shale layer in the upper part contains phosphatic nodules and pyrite with a dwarf fauna.

Introduction

The Nutwood Quadrangle is located about twenty miles north of St. Louis in Jersey, Greene and Calhoun Counties, Illinois. The quadrangle is dominantly driftless, except for the northeastern-most corner where Glasford Till (Illinoian) occurs north of Otter Creek. Two ice sheets advanced close to this area: Pre-Illinoian from the west and the Illinoian from the northeast, but neither crossed the majority of this quadrangle.

The oldest formation exposed is the Maquoketa Shale (Upper Ordovician); the youngest bedrock formations occurring in the study area are the Burlington-Keokuk Limestones (Mississippian). The Illinois River divides the quadrangle from north to south and has yielded high, precipitous bluffs on both sides of the river floodplain. The rocks are mainly horizontal with a few small synclines and anticlines. The best exposures occur near the bluffs and become mantled with loess away from the bluff line.

Structural Geology

The Nutwood Quadrangle lies north of the Cap au Gres faulted flexure; however, most of the structures are subtle within this quadrangle. The Meppen Syncline (Rubey 1952) is an east-west trending, gentle syncline with dips of 2° to the north on the south limb and dips of 3° to the south on the north limb. The syncline is recognized because the Silurian strata disappears in Sec. 23, T12S, R2W, then reappears to the north in Sec. 14 of the same township and range.

A small normal fault named herein is the Monterey School Fault, which trends N 35°E with the south side downthrown and positions Mississippian rocks against Silurian rocks in Sec. 10, T12S, R2W.

Another subtle structure named the Otter Creek Syncline (Rubey 1952) trends nearly east-west and has gentle dips to the north of about 3° north northeast from the south limb and 3° south southwest from the north limb. These dips were measured in Silurian strata that dip into Otter Creek. Additionally, a subtle structure occurs in 'The Narrows', Sec. 33 T8N, R13W, which Rubey (1952) named the Nutwood Anticline. This structure trends northwest according to Rubey but was not mapped by the author because a dip reversal from the Otter Creek Syncline was not observed. The strata in'the Narrows' are horizontal.

Most of the structures in the Nutwood Quadrangle appear to be small adjustments off of larger structures to the south and west, namely the Cap au Gres of Illinois and the Lincoln Fold of Missouri, respectively. Strata within this quadrangle are typically flat with an overall regional dip to the east northeast into the Illinois Basin.

Stratigraphy and Paleontology of the Bedrock Units

The oldest formation exposed in the study area is the Maquoketa Shale (Upper Ordovician). It is composed of siltstone in the upper part, which contains carbonaceous algal material. Most of the formation is a bluish claystone except for a dark shale layer known as the depauperate zone that yields phosphatic nodules and a dwarfed invertebrate fauna. The lower part of this formation is not exposed in the quadrangle but does contain crinoids, rare brachiopods, conularids and the trilobites *Ampyxina bellatula*, *Isotelus iowaensis*, and *Anataphrus* sp. at nearby locations in Illinois and Missouri.

The Silurian and Devonian rocks occur above the Maquoketa Shale and were mapped together because the dolostone is a consistent lithology and has a thickness appropriate for the 1:24,000 scale. The Devonian is thin and therefore included with the Silurian map unit. The Silurian is composed of three formations: Bowling Green, Kankakee, and Joliet, with disconformities below and above each formation. All of the Silurian units are composed of yellow dolostone with moldic porosity. Fossils found in the Silurian are internal molds and external casts of rugose corals, brachiopods, bryozoans and trilobites. The most common trilobite *Gravicalymene celebra* is mainly found in the upper third of the Silurian Joliet Formation. Other trilobites are rare but include *Cheirurus* sp., *Encrinurus* sp., *Bumastus oxis*, and *Dalmanites* sp.

The Devonian is composed of a fossiliferous brown to tan limestone that can be sandy or dolomitic in part. There are two Devonian formations in the quadrangle: the oldest is the upper Middle Devonian (Givetian) Cedar Valley Limestone and the youngest is the Upper Devonian Louisiana Limestone (Famennian). The Cedar Valley has numerous brachiopods which include *Mucrospirifer* sp., *Paraspirifer* sp., *Orthospirifer iowaensis*, *Ilita johnsonensis*, different species of atrypids, and strophominids. The large rugose corals, *Cystiphyllum* sp., and *Heliophyllum* sp., are also common in places along with large articulated and disarticulated crinoid stems. The Louisiana Limestone is a dense micrite that displays conchoidal fracture, and fossils are rare. It is unconformable with the underlying Cedar Valley Limestone. Both formations thicken to the north probably due to the affects of the Cap au Gres monoclinal flexure to the south, which was thought to have been active during Devonian time (Rubey 1952).

The oldest Mississippian formation is the Horton Creek Limestone. It is a fossil wackestone that contains brachiopods, ramose bryozoans and crinoid stems. This unit also thickens to the north from Sec. 4, T7N, R13W. Above the Horton Creek is the Hannibal Shale, which is typically a bluish-gray claystone but can have numerous silty beds. Fossils are rare. The Chouteau Limestone is thin, wavy-bedded, and cherty carbonate with disarticulated crinoid stems. It is mainly composed of carbonate mud. The Burlington/Keokuk Limestone is the youngest Mississippian formation in the quadrangle. It is a crinoidal grainstone. Although dominated by crinoid skeletal debris, disarticulated or fragmented brachiopods, rugose corals, bryozoans, and sea urchins are also found in the formation.

Tertiary deposits are composed of gravels, sand, silt and clay known as the Grover Gravel. Clasts are composed of banded iron, red quartzite, chert, and quartz pebbles. Exposures are poor and evidence for the gravel is commonly found in the alluvium of the ravines just below exposures atop the bedrock surface. The age is uncertain—Rubey (1952) conjectured Miocene to Pliocene/early Pleistocene. The gravel probably originated from the north as seen by the banded iron and red and purple quartzite pebbles.

Surficial Deposits

The oldest Pleistocene deposit is the Glasford Formation, glacial till from the Illinoian ice sheet. It is composed of clay, silt, sand, gravel and large glacial erratics. The glacial erratics are rounded pebbles and cobbles of igneous, metamorphic, and sedimentary origin. The Glasford is best seen in the northeast corner of the quadrangle north of Otter Creek. Ponded deposits during the Illinoian glaciation are found as varved or laminated sands and clays that fill local bedrock ravines just south of Otter Creek.

Wisconsinan sediments include slackwater deposits that are now geomorphic terraces in the Illinois River bottoms. These deposits are primarily comprised of sand, silt and clay.

Holocene deposits include alluvial sediments in large hollows on the Illinois River flood plain and fan deposits. The fan deposits are low conical geomorphic features that occur at the mouth of the creeks that flow onto the Illinois River flood plain.

Potential Geological Hazards

Two formations can be potential geologic hazards in the Nutwood Quadrangle: the Maquoketa Shale and Hannibal Shale. The hazard associated with these units is land failure or landslides. The Maquoketa Shale is overlain by porous dolostone which transports water down gradient to the shale which acts as an aquitard. This tends to pond water creating unstable conditions on the shale and in the overlying carbonate rocks. Silurian rocks have slumped on the Maquoketa in other quadrangles (Denny and Devera 2002).
The Hannibal Shale has the same relationship as described above with overlying limestones that have jointing or fracture porosity. The Hannibal Shale is a gummy clay when saturated and slope failures have been documented locally in the Grafton, Illinois area. Both shales occur within the Nutwood Quadrangle. Construction sites near these stratigraphic intervals should be well planned and special considerations should be a part of the building site especially if dip is in the down gradient direction.

Economic Geology

Limestone Aggregate
Only one limestone stone quarry was active within the Nutwood Quadrangle in Calhoun, County, NW Sec. 35, T11S, R14 W. The target stone was the Burlington/Keokuk Limestone, which was used for aggregate.

Other potential areas for quarries occur in the quadrangle. The Rosedale area has potential for Silurian building stone and dolostone aggregate. There is potential for calcium-rich limestone within the upper beds of the Burlington-Keokuk Limestone on the west side of the quadrangle and into the Foley Quadrangle.

Oil and Gas
One oil test hole was drilled by Carl Jensen in April of 1954 and was dry and abandoned. It was drilled to the St. Peter Sandstone at a total depth of 950 feet. The Isringhausen #1 was drilled in SW, Sec. 23, T8N, R13W. The potential for oil and gas in the quadrangle is minimal because the structures are subtle and the primary reservoir rock, the Kimmswick Limestone, is near the surface.

Acknowledgments

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