GEOLOGY OF JOPPA QUADRANGLE
MASSAC COUNTY, ILLINOIS

Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

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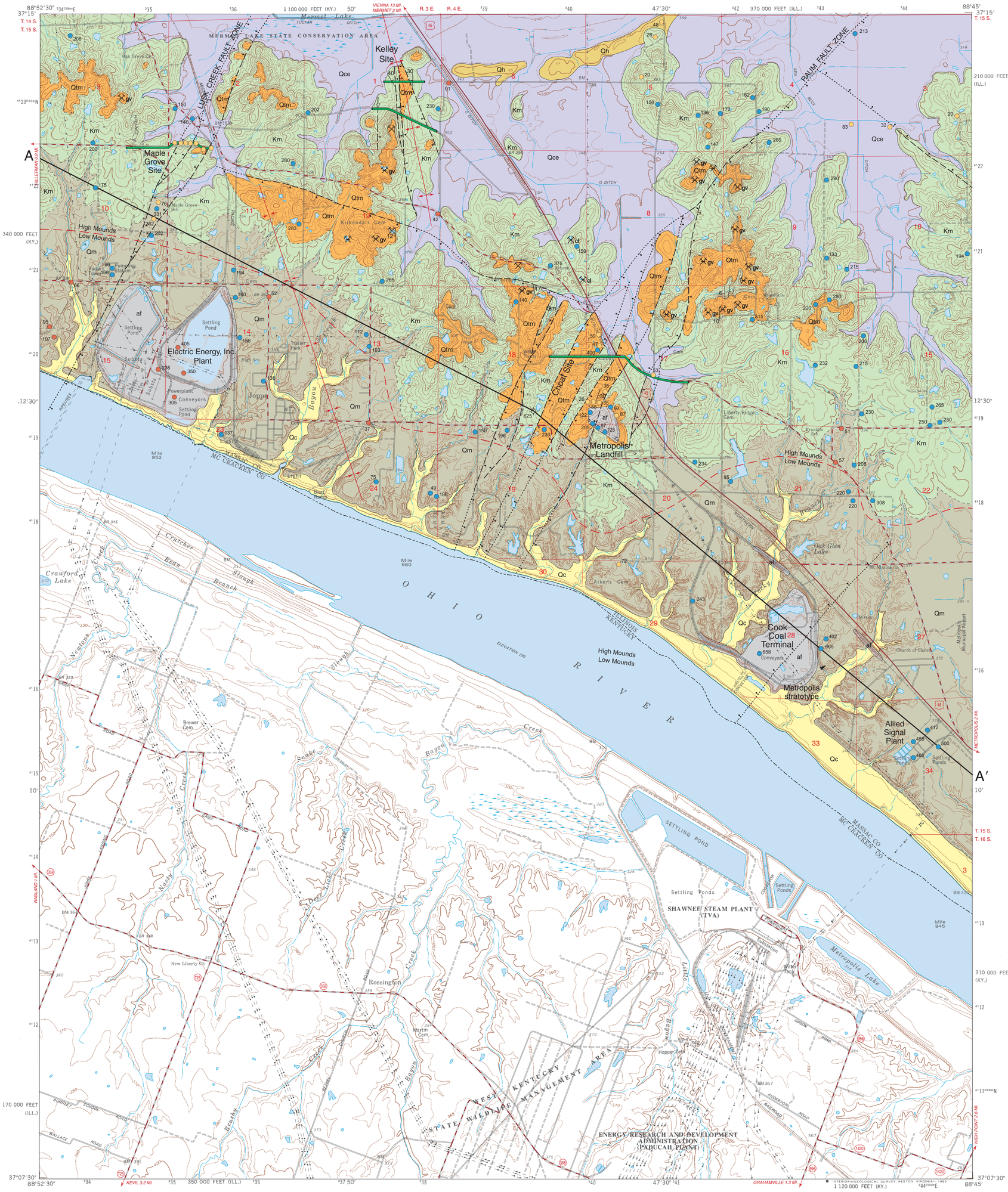
2008

Illinois Geologic Quadrangle Map
IGQ Joppa-G



EXPLANATION

	af	Artificial fill	
Quaternary	Qc	Cahokia Formation	Holocene
	Qce	Cahokia and Equality Formations	
	Qh	Henry Formation	Pleistocene
Unconformity			
	Qm	Metropolis Formation	
Tertiary	QTm	Mounds Gravel	Pliocene and Miocene
Unconformity			
Cretaceous	Km	McNairy Formation	Maastrichtian

Note: Loess deposits, comprising the Peoria, Roxana, and Loveland Silts, cover nearly all upland areas of the Joppa Quadrangle. These units are not shown on the geologic map.

Symbols

- 40 — Strike and dip of bedding; number indicates degree of dip
- Outcrop of special note, shown where contact or map unit was well exposed at time of mapping
- Active pit or quarry; cl, clay; gv, gravel
- Abandoned pit or quarry

Drill Holes

- Stratigraphic boring
- Water well
- Engineering boring
- Dry oil test hole
- 54 — 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
- Boundary between high Mounds Gravel (above 380 feet elevation) and low Mounds Gravel (below 380 feet elevation)
- Line of seismic reflection profile
- A—A′ — Line of cross section

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

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Illinois topography compiled from imagery dated 1965, field checked 1987. Kentucky planimetry compiled from imagery dated 1952; topography from plane tables 1954, revised from imagery dated 1978. Field checked 1978. Topographic map edited 1982. Hydrography digital update 1993.

North American Datum of 1927 (NAD 27)
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

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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 10 FEET
SUPPLEMENTARY 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 J. Nelson and J. Masters, 1997–1999.

Digital cartography by J. Domier, M. Bentley, B. Stiff, M. Widener, and S. Geegan, Illinois State Geological Survey.

The Illinois State Geological Survey, the Illinois Department of Natural Resources, and the State of Illinois make no guarantee, expressed or implied, regarding the correctness of the interpretations presented in this document and accept no liability for the consequences of decisions made by others on the basis of the information presented here. The geologic interpretations are based on data that may vary with respect to accuracy of geographic location, the type and quantity of data available at each location, and the scientific and technical qualifications of the data sources. Maps or cross sections in this document are not meant to be enlarged.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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1	2	3
4		5
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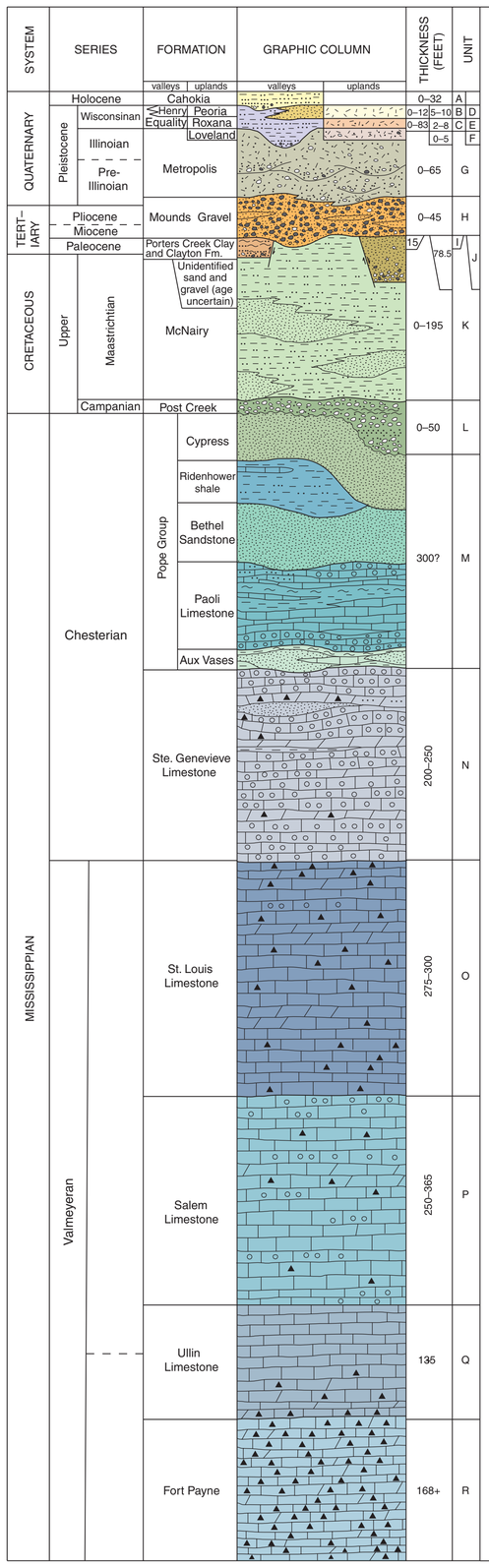
ADJOINING QUADRANGLES
1 Karnak
2 Mermet
3 Reevesville
4 Bandana
5 Metropolis
6 La Center, KY
7 Heath, KY
8 Paducah West

APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

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



A Cahokia Formation Silt, clay, sand, and gravel. Silt and clay are mostly mottled brownish gray and massive to indistinctly bedded; they contain lenses of sand and gravel. Gravel consists dominantly of chert pebbles that are derived from Mounds Gravel but are bleached, worn, and pitted. Well-preserved plant matter is common. Clean sand and minor gravel are present in the modern Ohio River channel. The Cahokia comprises alluvial deposits on modern floodplains. The lower contact is gradational and difficult to identify where this unit rests on the Equality Formation. This unit corresponds to "alluvium" in Kentucky (Finch 1967). Elsewhere, the lower contact is erosional.

B Henry Formation Sand. Yellowish gray to yellowish brown sand is very fine- to fine-grained, becoming finer upward and having a silt matrix near the top. The Henry is mapped on the low, arcuate ridge bordering the Cache Valley in Sec. 5 and 6, T15S, R4E, near the northern edge of the quadrangle. The presence of the Henry is deduced from a single cored test hole (ISGS No. 3 Stratemeyer) and from the soil map of Parks et al. (1975), which shows the Wheeling silt loam along this ridge. Although the unit is not shown on this map sheet, the Wheeling soil series is characterized as silty loam that grades downward to silty sand. In the Stratemeyer core, sand interpreted as Henry Formation is 12 feet thick and underlies Peoria Silt and overlies Equality Formation, both contacts being gradational. The morphology of the sandy ridge suggests a longitudinal sand bar formed by the ancestral Ohio River in the Cache Valley.

C Equality Formation Clay, silt, sand, and gravel. Dominantly brownish to bluish gray, stiff to plastic, massive to laminated clay, silty clay, and clayey silt. Clay commonly contains small gastropods and well-preserved plant matter. Lenses of sand and gravel are present, mainly in the lower part of the unit. Equality Formation is interpreted as slack-water or overbank deposits in tributaries to the Cache Valley, which carried the flow of the Ohio River and probably the Tennessee and Cumberland Rivers during the late Pleistocene (Masters and Reinertsen 1987, Esling et al. 1989). The lower contact is erosional.

D Peoria Silt Silt. Silt is mottled yellowish gray to yellowish brown and massive; silt contains small concretions and stains of iron and manganese oxide. The Peoria is loess, wind-blown silt that was deposited near the end of Wisconsinan time about 10,000 to 15,000 years ago. Nearly all upland surfaces are mantled by Peoria Silt, and the modern soil is developed in the upper part. The lower contact is gradational. Unit is not shown on geologic map.

E Roxana Silt Silt. Silt is medium brown, commonly with a faint reddish cast, and may be slightly mottled. It is massive and contains a little more clay than the Peoria. The Roxana is loess deposited during the middle part of Wisconsinan time, about 28,000 to 50,000 years ago. The Roxana underlies Peoria Silt in uplands, and the Farmdale Geosol, a buried soil, commonly is developed in the Roxana. The lower contact is gradational. Unit is not shown on geologic map.

F Loveland Silt Silt. Silt is strongly mottled in yellow, orange, and gray; it is massive and commonly sandy, especially near the base. The Loveland is clay-rich and contains clay-filled fractures and cavities. The Loveland is loess deposited during Illinoian time (130,000 to 180,000 years before present). The Sangamon Geosol, a thick and strongly developed ancient soil, is developed in the Loveland. The Loveland is a discontinuous unit, but it occurs in uplands throughout the quadrangle. The lower contact is gradational to the Metropolis Formation and sharp to older units. Unit is not shown on geologic map.

G Metropolis Formation Silt, sand, clay, and gravel. The Metropolis is composed of silty sand and sandy silt, having a clay matrix and containing scattered chert and quartz pebbles and lenses of clean sand and gravel. Colors are strongly mottled in brownish gray, yellowish brown, and yellowish orange and are locally bright red to orange. Bedding is absent to weakly developed. The sediments are deeply weathered and thoroughly burrowed and contain multiple buried soil horizons. Chert pebbles are reworked from the Mounds Gravel. Some pebbles exhibit a worn brown or bronze patina, but most are bleached and pitted. The Metropolis contains multiple sequences that grade from gravel at the base to silt at the top. At its type locality in a ravine at the Cook Coal Terminal (1,800' SL, 1,500' EL, Sec. 28, T15S, R4E), the Metropolis exhibits low-angle accretionary bedding, which suggests that the sediment was deposited by small, meandering streams (Nelson et al.1999, p. 395–396).

The Metropolis is interpreted as fluvial sediments that occupied an underfit valley ancestral to the modern Ohio River. Streams that deposited the Metropolis evidently were small and sluggish. The sediment was subjected to long periods of weathering and soil formation. The Metropolis Formation underlies a subtle terrace that was named from the Metropolis terrace by Alexander and Prior (1968). The upper surface of the Metropolis terrace stands near the 400-foot elevation contour near the Ohio River and is capped by Loveland, Roxana, and Peoria loesses. South of the boundary between high and low Mounds marked on the geologic map, the Metropolis Formation overlies the Mounds Gravel with a gradational contact. North of that boundary, the Metropolis unconformably overlies the McNairy Formation. This unit corresponds to the "silt and sand deposits" in Kentucky on the map of Finch (1967).

H Mounds Gravel Gravel and sand. The Mounds Gravel is principally gravel that is composed of chert pebbles ranging up to about 4 inches in diameter and lesser quantities of quartz pebbles up to 0.5 inch across. Chert pebbles are subrounded to well-rounded and bear a glossy yellowish brown to bronze patina of iron oxide. Quartz pebbles tend to be well-rounded. The matrix is largely reddish brown to reddish orange, coarse, poorly sorted sand composed mainly of quartz grains. Gravel is crudely layered or cross-bedded and contains lenses of sand. The upper part of the Mounds includes sand that is bright red to orange, fine to coarse grained, has a clay matrix, and contains scattered chert granules. The sand lacks mica and has indistinct layering. Sand of the Mounds is exposed at the northwest corner of the Metropolis landfill, where it is dropped into a graben. In the northern part of the quadrangle, the Mounds Gravel caps hills at elevations above 380 feet. Near the Ohio River, the Mounds underlies the Metropolis Formation at elevations below 380 feet. The high Mounds and low Mounds are identical in lithology. The boundary between high Mounds and low Mounds is marked on the geologic map. The Mounds is interpreted as deposits of large, braided rivers that were at least partly ancestral to the modern Tennessee River (Potter 1955, Olive 1980, Nelson et al. 1999). The high Mounds represents an older stage of river deposition, and the low Mounds represents a younger, more deeply incised stage in a valley subsequently occupied by the modern lower Tennessee and Ohio Rivers. When Mounds deposition ended (early Pleistocene), the Tennessee and Cumberland Rivers flowed north through Smithland Gap and joined the Ohio River in the Cache Valley (Nelson et al. 1999). The Mounds Gravel is equivalent to "continental deposits" of western Kentucky (Finch 1967, Olive 1980) and the Lafayette Gravel of Tennessee. The lower contact is erosional.

I Porters Creek and Clayton Formations Clay and sandy clay. About 4 feet of clay identified as Porters Creek (Paleocene) was cored in the ISGS M. Kueger No. 3 borehole (Sec. 17, T15S, R4E) at a depth of 31 to 35 feet. The clay is light olive-gray with yellowish orange mottling, is stiff and massive, and breaks with conchoidal fracture. The lower part of the interval contains laminae and lenses of glauconitic sand. About 15 feet of sandy clay identified as the Clayton Formation (Paleocene) was cored at a depth of 30 to 45 feet in the ISGS City of Metropolis Landfill No. 1 borehole (also in Sec.17, T15S, R4E). The sandy clay, mottled in gray to yellowish orange, is highly glauconitic and contains numerous inclusions of sand that appear to be infilled burrows. In both cases, these are probable Paleocene sediments that overlie the McNairy Formation and underlie the Mounds Gravel within downfaulted blocks in the Raum Fault Zone.

J Unidentified sand and gravel Sand, gravel, minor silt, and clay. Core samples from the ISGS No. 2 Maple Grove School boring (Sec. 10, T15S, R3E) contain an unidentified sand and gravel from 48.5 to 127.0 feet, an interval 78.5 feet thick. The upper 61.5 feet is dominantly sand that is light gray to pale yellow and orange with local red mottling and is very fine to medium grained with scattered coarse grains and small granules of chert and quartz. The sand is loose to weakly indurated and generally massive, although faint laminations (dipping about 30°) were observed in places. Mica flakes are rare. Interbeds of silty sand to silty clay occur in the lower part of the sand. The basal 17 feet is composed of dark gray chert pebbles, some of which are tripolitic and some of which show bioclastic and oolitic texture and 10% quartz pebbles. None of the pebbles bears the brown patina characteristic of the Mounds. The gravel has a matrix of quartz sand and is not indurated. No fossils (aside from Paleozoic bioclasts in chert pebbles) or organic material was found. The unit overlies McNairy Formation and is overlain by Metropolis Formation; thus, the unit could be as old as Late Cretaceous or as young as Early Pleistocene. The No. 2 Maple Grove School borehole was drilled into a narrow graben within the Lusk Creek Fault Zone. The unit may be either sediment that was deposited within the graben while it was forming or part of a unit that originally covered a larger area, but was faulted down and preserved only here. Among known units in the region, the sand and gravel is most similar to the Eocene Wilcox Formation, which contains clean sand with small granules similar to those in the school core.

K McNairy Formation Sand, silt, and clay. Sand is mostly light gray to yellowish and brownish gray in well samples, but in outcrops it is oxidized to bright red, orange, and yellow. It is very fine- to fine-grained, less commonly is medium to coarse grained, and is composed mostly of quartz, but contains abundant fine mica flakes. Some sand is cross-bedded, and some has ripple and planar lamination. Silt and clay vary from medium to dark gray, brownish, and bluish gray and may be massive or blocky to thinly laminated. Clay, silt, and sand commonly are interlaminated, lending a striped appearance to outcrops and cores. In several locations, pairs of thin and thick planar laminae are arranged in regular bundles that are highly suggestive of neap and spring tidal depositional cycles. Clay and silt intervals contain lenses, bands, and concretions of limonitic ironstone. No fossils other than burrows and other indistinct traces were found.

The McNairy is interpreted as delta and shoreline deposits of the Mississippi Embayment, an arm of the Gulf of Mexico that extended as far north as southern Illinois near the end of the Cretaceous Period (Potter and Pryor 1961). The McNairy rests either on the Post Creek Formation with a gradational contact or on bedrock with an erosional contact.

L Post Creek Formation Gravel, sand, and clay. This unit is largely gravel composed of subrounded to well-rounded chert pebbles that are white to light gray, opaque, slightly porous, and partly tripolitic. Less common are medium to dark brown chert pebbles and well-rounded small white quartz pebbles and granules. The matrix is fine to very coarse, unsorted quartz sand in which the finer grains are subrounded and the larger ones are well-rounded. Sand is intermixed with dark gray, pyritic silt, and clay. Previously called the Tuscaloosa Formation, the Post Creek was named by Harrison and Litwin (1997) for exposures along Post Creek Cutoff in eastern Pulaski County. The Post Creek does not crop out in the Joppa Quadrangle; its description is based on samples from wells. This unit commonly overlies a rubble zone of chert fragments derived from prolonged weathering of cherty limestone during Cretaceous (and earlier?) time.

M Pope Group Limestone, sandstone, and shale. This upper Mississippian group contains several alternating limestone-shale and sandstone-shale formations. Limestone is mostly gray to brown, fine to coarse grained, commonly oolitic, and bioclastic. Shale is medium to dark gray and greenish gray, fissile, and partly silty. Red and green variegated mudstone also is present. Sandstone is light gray to greenish gray, very fine to medium grained, and partly calcareous. These strata are projected into the Joppa Quadrangle from the neighboring Reevesville (Nelson 1996) and Mermet (Devera and Nelson 1998) Quadrangles, and the description is based on outcrops and well records in those quadrangles. Units as young as the Cypress Formation may be present within the Joppa Quadrangle.

N Ste. Genevieve Limestone Limestone, minor dolomite, shale, and sandstone. Light to medium gray, oolitic, and partly sandy limestone is most typical. The Ste. Genevieve also contains darker gray, dense and micritic limestone and dolomite, along with thin interbeds of greenish gray sandstone and gray to green shale. The Ste. Genevieve is projected into the map area from the neighboring Reevesville (Nelson 1996) and Mermet (Devera and Nelson 1998) Quadrangles, and the description is based on well records in those quadrangles. The Chesterian-Valmeyeran series boundary is considered to lie at the base of the Ste. Genevieve on the basis of regional study by Nelson et al. (2002).

O St. Louis Limestone Cherty limestone and minor dolomite. Well samples from the map area consist mainly of microgranular limestone and dolomite along with fine-grained dolomitic limestone with scattered fossil fragments (wackestone and packstone). Colors vary from medium to dark gray and brownish gray. Oolitic limestone is uncommon. Chert in the St. Louis is mostly dark gray to black and vitreous. The upper contact was not logged; the lower probably is gradational.

P Salem Limestone Limestone. Colors vary from very light gray to dark gray and brownish gray; grain size is variable. Sand-size fossil grains occur in a microgranular matrix (wackestone and packstone) with scattered larger fossils that include echinoderms, bryozoans, corals, and brachiopods. Coarser-grained rock tends to be lighter in color. Fossil grains commonly are rounded, and oolites are present. Some beds are dolomitic and more or less recrystallized, obscuring the original texture. Chert, a minor constituent, is mostly light gray, dull-lustered, and opaque. No wells in the Joppa Quadrangle completely penetrated the Salem. The minimum thickness is 250 feet, but well logs in adjacent quadrangles indicate 320 to 365 feet of Salem.

Q Ullin Limestone Limestone. The upper Ullin is mostly limestone that is light gray to yellowish gray or buff and composed of large fragments of fenestellid bryozoans mixed with scattered echinoderm fragments. The grains are unsorted and rarely rounded or coated. The rock may be classified as packstone, grainstone, or bafflestone. Downward the rock changes gradually to medium to dark gray, fine- to medium-grained wackestone and packstone of bryozoan and echinoderm fragments. Bluish gray, semi-vitreous chert fragments make up as much as 20% of the sample volume in the lower Ullin. Thickness is approximately 135 feet; both contacts appear gradational.

R Fort Payne Formation Cherty limestone. The limestone is dark brownish gray, microgranular, siliceous, dolomitic, and pyritic. Most of the Fort Payne can be classified as calcisiltite (limestone composed of silt-sized grains); however, some lighter-colored limestone that appears to be recrystallized wackestone or packstone occurs in the upper 100 feet. Identifiable fossil grains are not common; they are bryozoans and echinoderms. Chert is dark-colored, opaque to semi-vitreous; it constitutes 5% to 10% of cuttings samples by volume. The deepest penetration of the Fort Payne in the map area was 168 feet. In the Glen Kahle No. 1 Harvick oil test hole, less than three miles north of the Joppa Quadrangle (Sec. 23, T14S, R3E), the Fort Payne is 685 feet thick, which is close to a maximum for the Illinois Basin.

Note: See accompanying report for references.