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ILLINOIS STATE GEOLOGICAL SURVEY
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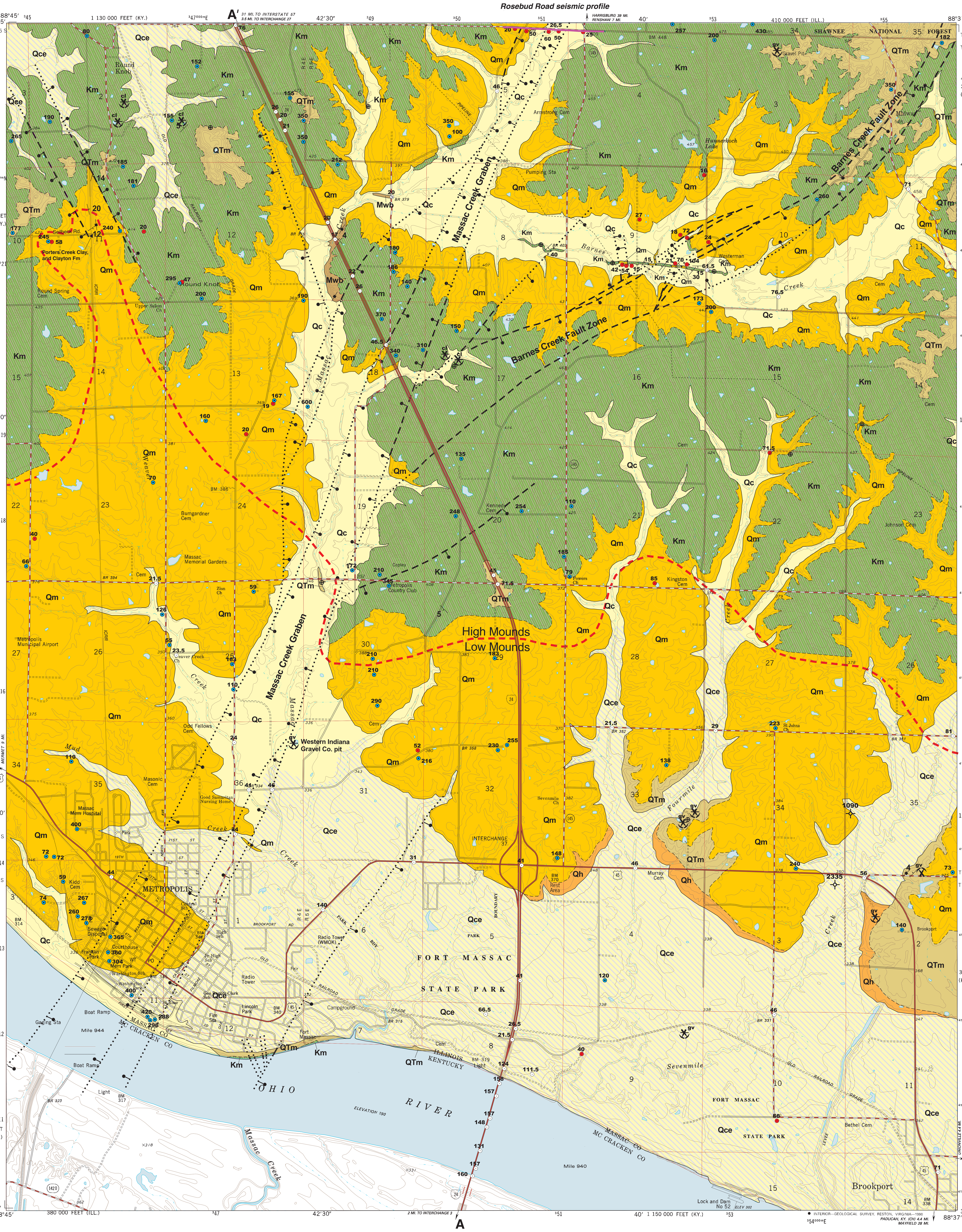
Illinois Geologic Quadrangle Map: IGQ Metropolis-SG, sheet 1 of 2
2002

SURFICIAL GEOLOGY

Metropolis Quadrangle, Massac County, Illinois

W. John Nelson, John M. Masters, and Leon R. Follmer

Rosebud Road seismic profile



Mapped, edited, and published by the Geological Survey
Revised in cooperation with Kentucky Geological Survey
Control by USGS and NOS/NOAA
Topography of Illinois area by photogrammetric methods from aerial photographs taken 1965. Field checked 1966-67. Planimetry of Kentucky area by photogrammetric methods from aerial photographs taken 1952. Topography by planetable surveys 1954. Revised from aerial photographs taken 1978. Field checked 1978. Map edited 1982
Polyconic projection. 10,000-foot grid ticks based on Illinois coordinate system, east zone and Kentucky coordinate system, south zone
1,000-meter Universal Transverse Mercator grid zone 16
1927 North American Datum

Scale 1:24,000

0 — 2 miles
0 — 2 kilometers
0 — 2,000 feet

BASE MAP CONTOUR INTERVAL 10 FEET

Base map compiled at the Illinois State Geological Survey (ISGS) from 1993 digital data provided by the U.S. Geological Survey and the ISGS
1927 North American Datum
Universal Transverse Mercator grid, zone 16

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UTM GRID AND 1997 MAGNETIC NORTH DECLINATION AT CENTER OF MAP

1	2	3
4		5
6	7	8

1 Mermet
2 Reevesville
3 Brownfield
4 Joppa
5 Paducah NE
6 Heath
7 Paducah West
8 Paducah East

ADJOINING 7.5-MINUTE QUADRANGLES

SYSTEM	SERIES and STAGE		FORMATION	MEMBER	THICKNESS (feet)	UNIT
QUATERNARY	Holocene		Cahokia		0–32	A
QUATERNARY	Pleistocene	Wisconsinan	Equality / Henry	Peoria	0–35 / 0–20 / 5–20	B / C / D
				Roxana	2–4	E
				Loveland	0–6	F
		Illinoian	Metropolis		0–80	G
		Pre-Illinoian				
TERTIARY	Pliocene		Mounds Gravel		0–55	H
	Miocene					
	Paleocene		Porters Creek Clay / Clayton Fm.		4.5	I
CRETACEOUS	Upper	Maastrichtian	McNairy		0–200	J
		Campanian	Post Creek		0–60	K
MISSISSIPPIAN	Chesterian		Golconda	Haney Ls. / Fraileys Sh. / Beech Creek Ls.	125–170	L
			West Baden Ss.		200–250	M
			Paoli Ls.	Downeys Bluff Ls. / Yankeetown / Shetlerville Ls. / Levias Ls.	115–150	N
			Aux Vases		15–25	O
			Ste. Genevieve Ls.		200–250	P
	Valmeyeran		St. Louis Ls.		280–350	Q
			Salem Ls.		320–365	R
			Ullin Ls.		135	S
			Fort Payne		500+	T

Note: Some Mississippian units are not drawn to scale.

UNIT DESCRIPTIONS

A Cahokia Formation. *Clay, silt, sand, and gravel.* Largely brownish gray, mottled silty clay and clayey silt that is massive to indistinctly bedded and contains 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 flood plains. The lower contact is gradational and difficult to identify where this unit rests on the Equality Formation. Elsewhere, the lower contact is erosional.

B Equality Formation. *Clay, silt, sand, and gravel.* Dominantly brownish to bluish gray, stiff to plastic, massive to laminated clay, silty clay, and clayey silt. Well-preserved plant matter is common. Lenses of sand and gravel are present, mainly in the lower part of the unit. Where it borders the Ohio River, the Equality Formation represents deposits of Lake Paducah, a lake that existed in what is now the Ohio Valley during the Wisconsinan age (Finch et al. 1964, Olive 1966). Equality Formation in the two northwest-trending valleys at the northwest corner of the quadrangle 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). Lower contact is erosional.

C Henry Formation. *Sand and gravel.* Sand is fine to coarse, composed largely of well-rounded quartz grains with abundant mica. Gravel consists primarily of well-rounded chert pebbles that range up to 3 inches in diameter. Chert pebbles are white to gray, black, and red; many of them bear a worn brown patina and were derived from the older Mounds Gravel. The Henry Formation forms low, linear to arcuate ridges at the border of the Ohio River flood plain in the southeastern part of the map area. These ridges are interpreted as bars or beach ridges that formed along the shoreline of glacial Lake Paducah (Finch et al. 1964). The ridges are mantled by the Peoria Silt, and the Henry Formation is not currently exposed within the Metropolis Quadrangle. The Henry Formation is mapped here on the basis of geomorphology, and the description is based on exposures in the adjacent Paducah Northeast Quadrangle.

D Peoria Silt. *Silt* is mottled yellowish gray to yellowish brown, massive, and contains small pellets and crack-fillings of iron and manganese oxide. The Peoria is loess: silt that was deposited by the wind near the end of the Wisconsin glaciation, about 10,000 to 15,000 years ago. Nearly all upland surfaces are mantled in Peoria Silt, and the modern soil is developed in the upper part. The lower contact is gradational. *Not mapped.*

E Roxana Silt. *Silt* is medium brown, commonly with a reddish cast, and may be faintly mottled. It is massive and contains a little more clay than the Peoria. The Roxana is loess: silt that was deposited by the wind during the middle part of the Wisconsin glaciation, about 20,000 to 25,000 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. *Not mapped.*

F Loveland Silt. *Silt* is strongly mottled in yellow, orange, and gray; it is massive to blocky and commonly sandy, especially near the base. The Loveland is clay-rich and contains clay-filled fractures and cavities. The Loveland is loess: silt that was deposited by the wind during the late Illinois glaciation. The Sangamon Geosol, a thick and strongly developed ancient soil, is developed in the Loveland. This unit is lenticular, but found in uplands throughout the quadrangle. The lower contact to Metropolis is gradational, but sharp to older units. *Not mapped.*

G Metropolis Formation. *Silt, sand, clay, and gravel.* Dominantly a diamicton 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, yellowish orange, and locally bright red to orange. Bedding is absent to weakly developed. The sediments are deeply weathered, 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. This formation was named by Nelson et al. (1998) and is interpreted as fluvial sediments that occupied an underfit valley ancestral to the modern Ohio. 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 *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. The terrace surface rises gradually up the valleys of Massac and Barnes Creeks. Overlying the Metropolis on the terrace is the Loveland Silt, a loess deposit of Illinoian age. South of the "low Mounds-high Mounds" boundary marked on the geologic map, the Metropolis overlies the Mounds Gravel with a gradational contact. North of that boundary, the Metropolis unconformably overlies the McNairy Formation or, locally, Mississippian sandstone.

H Mounds Gravel. *Gravel and sand.* 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 sub-rounded 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. In the northern part of the quadrangle, the Mounds Gravel caps hills at elevations of 450 feet or higher. In the southern part of the map area, the Mounds underlies the Metropolis Formation at elevations below 380 feet. 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 and to the Lafayette Gravel of Tennessee. The lower contact is erosional.

I Porters Creek and Clayton Formations. *Clay and sandy clay.* A single outcrop, too small to show at the scale of the map, was found in a gully on the east side of the Illinois Central Railroad just north of Seilbeck Road (location arrow near center, Sec. 11, T15S, R4E). Two feet of light olive-gray, silty, stiff, weakly laminated clay that weathers yellowish orange is identified as Porters Creek. Below the clay, hand augering revealed 2.5 feet of olive to greenish gray, sandy clay that is blocky to weakly laminated and contains abundant glauconite. This lithology is diagnostic for the Clayton Formation. The Clayton in turn overlies micaceous sand of the McNairy Formation. The Porters Creek and Clayton are marine sediments of Paleocene (early Tertiary) age. They are widespread south of the map area, but elsewhere in the Metropolis Quadrangle, they were eroded prior to deposition of the Mounds Gravel. Their presence here, underlying exposures of Metropolis Formation that are tilted and cut by small faults, signifies that a fault block was lowered and protected from erosion during the Tertiary Period.

J McNairy Formation. *Sand, silt, and clay.* Sand is mostly light gray to yellowish and brownish gray in well samples, but in outcrops it is brightly colored in red, orange, and yellow. It is very fine- to fine-grained, less commonly medium- to coarse-grained, and composed mostly of quartz, but contains abundant fine mica flakes. Some sand is cross-bedded; some has ripple and planar lamination. Laminae and rip-up clasts (clay galls) of light gray clay are common. Lenses of white, well-sorted, pure quartz sand similar to the "Commerce quartzite" of southeastern Missouri are present. 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. 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.

K Post Creek Formation. *Gravel, sand, and clay.* This unit is largely gravel composed of sub-rounded 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 sub-rounded and the larger ones 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 Metropolis 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.

L Golconda Formation. *Limestone and shale.* Drillers' logs of water wells indicate limestone interbedded with gray to green shale. More detailed well records and outcrops in adjacent quadrangles show the Golconda is divisible into three units: (1) the *Haney Limestone Member* at the top, composed of limestone with thin shale interbeds; (2) the *Fraileys Shale Member*, mostly dark gray shale with thin limestone interbeds and an interval of red and green mudstone at the top; and (3) the thin *Beech Creek Limestone Member* at the base.

M West Baden Sandstone. *Sandstone, siltstone, and shale.* This unit crops out along Massac Creek near Interstate 24, where it is largely sandstone that is light gray and very fine- to fine-grained. Nearly pure quartz, the sandstone displays thin wavy to lenticular bedding, ripple marks, clay drapes, small horizontal burrows, and small load casts. Thick-bedded sandstone is at the top, and dark gray shale interbeds occur near the base. The outcrops show only about 30 feet of a unit that totals 200 to 250 feet thick, according to well records. The West Baden is equivalent to the Cypress (youngest), Sample, and Bethel Sandstones of neighboring areas.

N Paoli Limestone. *Limestone, shale, mudstone, and siltstone.* Drillers' logs of water wells indicate limestone with shale interbeds. Outcrops and cores from nearby quadrangles show the Paoli to be divisible into four members. From the top down, they are (1) *Downeys Bluff Limestone Member*, white to gray, coarse-grained fossiliferous and oolitic limestone with thin interbeds of gray to green shale; (2) *Yankeetown Member,* gray, green, and red siltstone, shale, and mudstone with thin interbeds of limestone; (3) *Shetlerville Limestone Member,* light to dark gray fossiliferous limestone with thin shale beds; and (4) *Levias Limestone Member*, white to light gray and pink, oolitic limestone.

O Aux Vases Sandstone. *Sandstone, siltstone, and limestone.* Water-well records indicate the unit is present, but provide no details. The Aux Vases in southeastern Illinois typically consists of light gray to greenish gray siltstone to very fine-grained sandstone that is calcareous and grades laterally to sandy limestone.

P Ste. Genevieve Limestone. *Limestone, minor dolomite, shale, and sandstone.* Water-well logs indicate the unit is present, but give no details. In neighboring areas, the Ste. Genevieve is largely white to gray limestone, much of which is oolitic, but beds of darker, fine-grained dolomitic and cherty limestone are present. Thin interbeds of green to gray shale and gray to green, calcareous sandstone may occur in the upper part.

Q St. Louis Limestone. *Cherty limestone and minor dolomite.* Well samples from the southern part of 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. A minimum thickness is 280 feet. The upper contact was not logged; the lower probably is gradational.

R 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 micrGranular matrix (wackestone and packstone), with scattered larger fossils that include echinoderms, bryozoans, and brachiopods. Coarser-grained rock tends to be lighter in color. Some fossil grains are rounded, and oolites are present but less conspicuous than in the Ste. Genevieve. Some beds are dolomitic and more or less recrystallized, obscuring the original texture. Chert, a minor constituent, is mostly light gray, dull-textured, and opaque. Thickness is about 320 to 365 feet, but both contacts are difficult to identify precisely in well cuttings.

S Ullin Limestone. *Limestone.* Three wells having good samples penetrate this unit. The upper Ullin is mostly limestone that is light gray to yellowish gray or buff and is composed of large fragments of fenestellid bryozoans mixed with scattered echinoderm fragments. The grains are unsorted, and are rarely rounded or coated. The rock may be classified as packstone, grainstone, or bafflestone. Downward the rock changes gradually to medium-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 sample volume in the lower Ullin. Thickness is close to 135 feet in all three wells, although both contacts appear gradational.

T Fort Payne Formation. *Cherty limestone.* The limestone is dark brownish gray, microgranular, siliceous, dolomitic, and pyritic. Drillers commonly log it as black limestone or chert. 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, and constitutes 5% to 10% of samples by volume. No wells in the quadrangle provide samples completely through the Fort Payne. In the nearest well having complete penetration, the Glen Kahle no. 1 Harvick oil test hole in Sec. 23, T14S, R3E a few miles northwest of the map area, the Fort Payne is 685 feet thick, which is close to a maximum for the Illinois Basin.

Units

- Qc — Cahokia Formation
- Qce — Cahokia and Equality Formations
- Qh — Henry Formation
- Qm — Metropolis Formation
- QTm — Mounds Gravel
- Km — McNairy Formation
- Mwb — West Baden Sandstone

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

Line Symbols

Lines are dashed where inferred, dotted where concealed

- Contact (*Highly inferential contacts are "scratch"; that is, no line is used*)
- Fault; ball and bar on downthrown side
- Boundary between "high Mounds Gravel" and "low Mounds Gravel"
- A — A' Line of cross section (Note that Section A-A' follows Interstate Rt. 24)
- Seismic profile

Symbols

- Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joints or fractures
- Active pit, gv = gravel
- Abandoned pit, cl = clay, gv = gravel

Drill Holes from Which Subsurface Data Were Obtained

- 70 Water well, with depth in feet
- 56 Engineering boring, with depth in feet
- 20 ISGS stratigraphic test boring, with depth in feet
- 2335 Dry oil-test hole with depth in feet

- Primary highway
- Secondary highway
- Light duty road
- Unimproved; four-wheel drive
- Railroad

Metropolis Quadrangle: List of wells from which geologic information was obtained.

Massac County

Number[1]	Operator	Farm or Road	Type of Well	Location	Section	T.D.[2]	Formation at T.D.[3]	Type of Log(s)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[1]Number is ISGS county number, except for Illinois Department of Transportation (IDOT) and other engineering borings, for which the agency's number is given.
[2]T.D., total depth.
[3]Indicates IDOT bridge borings: in most cases, two or more holes were drilled at the same site. The record of the deepest hole at each site is listed here. Updated July 11, 2000.
[4]These borings are in Kentucky. Locations are projected into Section 8, T16S, R5E.