Institute of Natural Resource Sustainability
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ILLINOIS STATE GEOLOGICAL SURVEY
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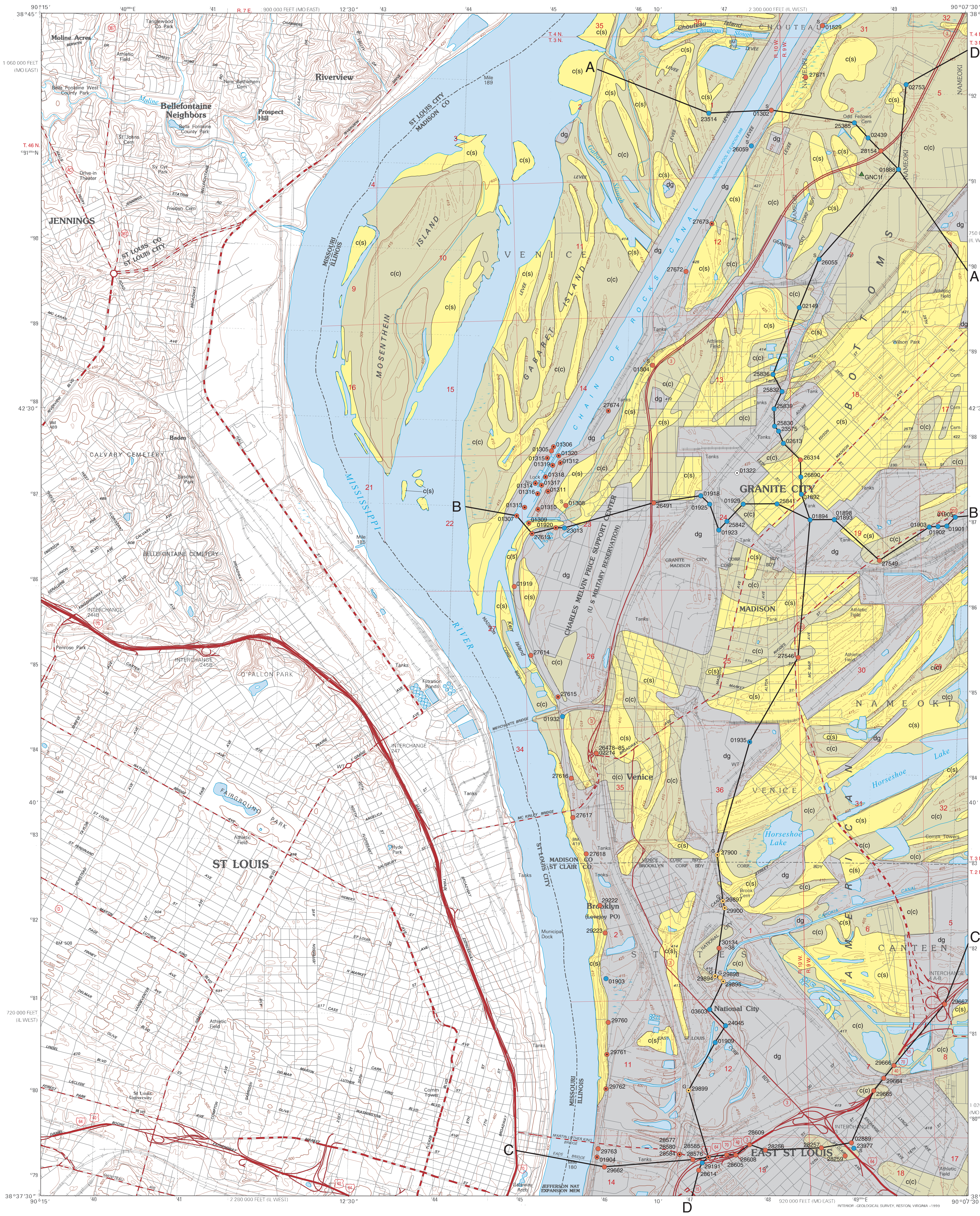
SURFICIAL GEOLOGY OF GRANITE CITY QUADRANGLE

MADISON AND ST. CLAIR COUNTIES, ILLINOIS

Andrew C. Phillips, David A. Grimley, and Scott W. Lepley
2009

Illinois Geologic Quadrangle Map
IGQ Granite City-SG



Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled 1933. Revised and updated from imagery dated 1998.

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

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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

Geology based on field work by A.C. Phillips, D.A. Grimley, S.W. Lepley, and C.S. Stohr, 2001–2003.

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

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QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,000 years before present (B. P.) to today)		
Fill or removed earth; sediment of various types	Disturbed ground dg	**Man-made materials** in interstate interchanges, landfills, sand and gravel pits, borrow pits, and Native American earthen mounds
Silty clay loam, silty clay, and silt with occasional fine sand lenses; gray to brown, some thin red layers, massive to well stratified; soft to stiff	Cahokia Formation, (clayey Mississippi Valley facies) c(c)	**Abandoned channel fill, swale fill, and backswamp alluvium;** deposited in floodplain of Mississippi River; interfingers with sandy facies of Cahokia Formation
Very fine, fine, and medium sand, with some coarse sand and gravel and some silt and clay layers; light brown to gray, stratified, loose to soft	Cahokia Formation, (sandy Mississippi Valley facies) c(s)	**Point bar and channel alluvium** of the Mississippi River; interfingers with clayey facies of Cahokia Formation
WISCONSIN EPISODE (~75,000 years–12,000 B.P.)		
Medium to coarse sand with gravel and some fine sand; fine sand where exposed near surface; light brown to gray to pinkish-brown, stratified, various pebble compositions	Henry Formation (cross sections only) h	**Glacial outwash** of the Mississippi River; buried by postglacial Cahokia alluvium
Silt to silt loam; yellow-brown to gray to pinkish-brown, massive with some dark organic layers, friable, mainly dolomitic, terrestrial gastropods common; contains modern soil solum in upper 2 to 4 feet, carbonate nodules common	Peoria and Roxana Silts (cross sections only) pr	**Loess;** including some slope deposits and redeposited loess; upper portion is Peoria Silt (tan to gray); lower portion is Roxana Silt (pink to tan-gray with higher clay content); mapped in Missouri on cross-sections
ILLINOIS EPISODE (~200,000 years–130,000 B.P.)		
Pebbly silt loam to loam diamicton with sand and silt lenses; olive to gray, weathered brown in upper portion; typically massive, dense, and weathered	Glasford Formation (cross sections only) g	**Till and ice marginal sediment;** upper portions may contain lower horizons of Sangamon Geosol; mapped in Missouri on cross-sections

Data Type

Stratigraphic boring

Water boring

Engineering boring

SG 29900 — Labels indicate samples (s) or geophysical log (c). Numeric labels indicate the county number. Outcrop labels indicate geologist's field number. Dot indicates boring is to bedrock.

Contact

Inferred 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. Online well and boring records are available at the ISGS Web site.

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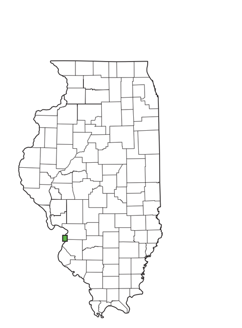

1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Florissant
2 Columbia Bottom
3 Wood River
4 Clayton
5 Monks Mound
6 Webster Groves
7 Cahokia
8 French Village

APPROXIMATE MEAN DECLINATION, 2006

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

DRAFT: THIS MAP IS IN REVIEW AND IS NOT YET PUBLISHED. 2.2.09

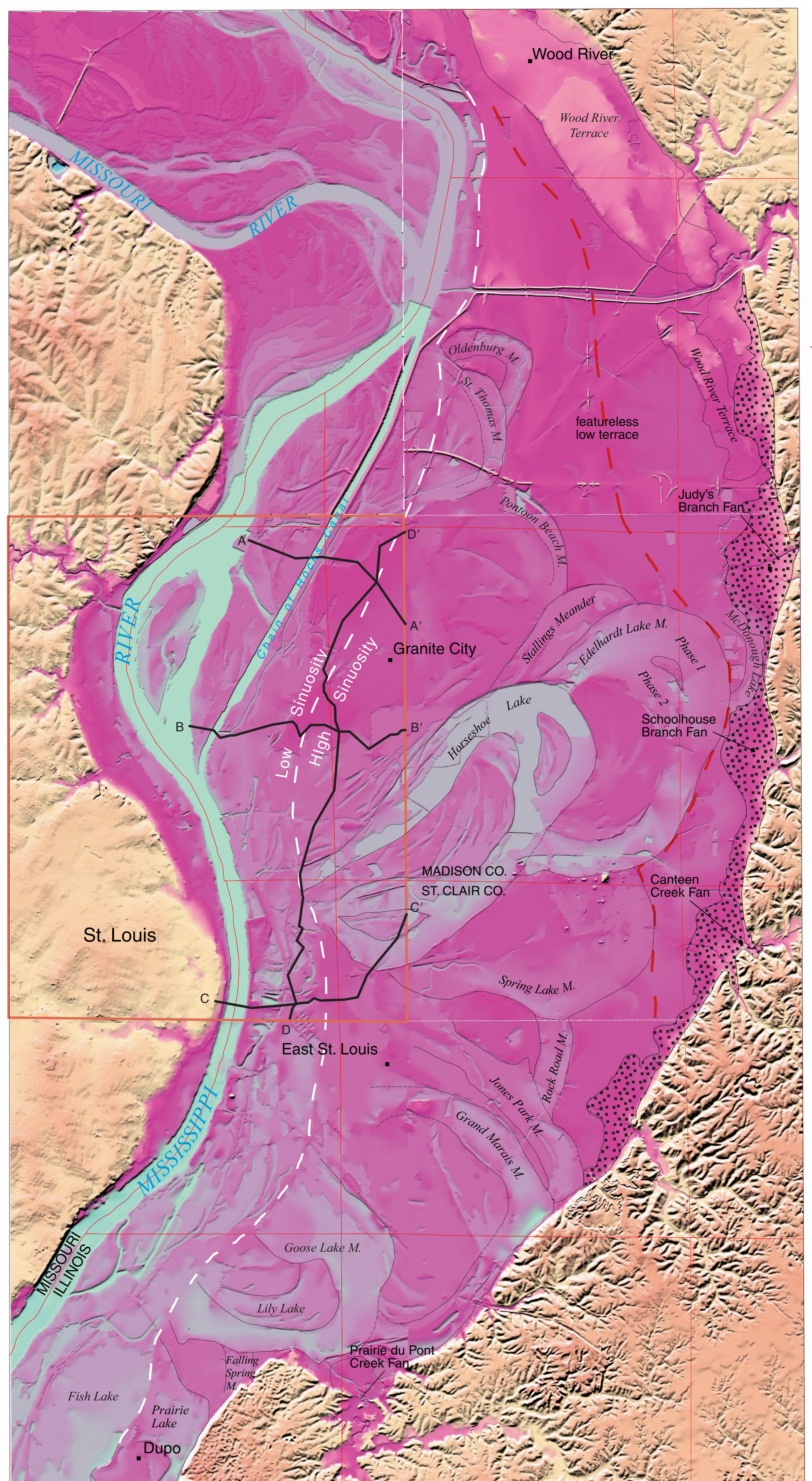

Figure 1 Physiographic map of a portion of the American Bottoms near East St. Louis, Illinois showing some named features. High elevations (uplands) are in tan, low elevations are in lavender to blue. Alluvial fans emanating from tributary valleys coalesce over valley fill deposits along the eastern bluff line. Four physiographic regions within the main valley reflect deposition and erosion from the evolving Mississippi River (see Table 1). Remnant late Wisconsin Episode glacial outwash exists east of the red dashed line. The Mississippi evolved from a braided outwash to a meandering system about 10,000 years ago. It then flowed only in the region west of the red line, eroding deeply into the pre-existing glacial deposits. The low featureless terrace is an erosional remnant of the glacial sediments although buried by post-glacial overbank sediments. High sinuosity meandering left prominent channel scars and point bar deposits over the central portion of the American Bottoms. The river evolved from high-sinuosity to low-sinuosity meandering by about 2400 years ago, after which it has only occupied the region west of the "sinuosity line". Base is a shaded relief map constructed from 6 tiled USGS 7.5 minute quadrangle digital elevation models with 10 m resolution. The Granite City quadrangle is indicated by the black box. Scale ~ 1:100,000.

Surficial deposits

The Granite City Quadrangle contains the modern Mississippi River, and adjacent portions of southwestern Illinois and St. Louis, Missouri. The mapped area in Illinois comprises a portion of the American Bottoms, a large alluvial valley of the Mississippi River, with up to 125 feet of waterlain clay, silt, sand, and gravel above bedrock. They are distributed in complex relationships caused by erosion of old glacial valley fill and migration and abandonment of more recent channels of the Mississippi. Bedrock is level to gently sloping underneath the American Bottoms, but rises rapidly adjacent to the present course of the Mississippi and ultimately crops out in St. Louis as well as in the river bed upstream of the quadrangle.

Upland Areas
Although mapping focused on the Illinois portion of Granite City quadrangle, uplands in Missouri are shown in cross-section C–C′ and are based upon Goodfield (1965) and our observations from the area (Grimley et al. 2001).

Illinois Episode deposits
A thin layer, less than 5 feet thick, of silt loam to loam diamicton (Glasford Formation) interpreted as till overlies bedrock (cross-section C–C′). It is lithologically variable, from highly weathered to slightly weathered, and may contain inclusions of pre-existing local sediments (Goodfield 1965, Grimley et al. 2001). Pebble to cobble clasts include metamorphic and igneous lithologies, and chert. The till was deposited when glacial ice advanced from Illinois over the ancestral Mississippi valley. The upper few feet of the deposit contains the soil weathering profile of the Sangamon Geosol and may include thin weathered silt deposited as loess during retreat of the Illinois Episode glaciers.

Wisconsin Episode deposits
Windblown silt (loess), up to 75 feet thick, blankets older deposits in upland areas. The loess deposits were correlated by Goodfield (1965) to the thick loess sequences on the eastern bluffs of the American Bottoms, which have been the focus of much research because of the fairly continuous record of past climates and events they can potentially reveal (Willman and Frye 1970, McKay 1977, Wang et al. 2000). The loess was derived from windswept outwash here in the Mississippi Valley and, to a lesser degree, the Missouri Valley. Loess deposits consist of the Peoria and Roxana Silts. The older Roxana Silt in Illinois is distinctively pinkish-brown in comparison to the yellow-brown Peoria Silt, but Goodfield (1965) found the color difference not always expressed in the field. The Roxana Silt is generally thinner and has slightly more sand, coarse silt, and clay than the Peoria Silt (McKay 1977). The Roxana Silt was deposited between about 55,000 and 28,000 radiocarbon years before present (RCYBP) and the Peoria Silt between about 25,000 and 12,000 RCYBP (McKay 1977, Grimley et al. 1998, Wang et al. 2000). Dark organic bands within the Peoria Silt represent warmer interstadial periods of soil formation (Wang et al. 2000). Both loess units contain large terrestrial gastropods locally.

American Bottoms
Filling and excavation of the Mississippi valley by meltwater events are likely to have occurred several times during the Quaternary Period. River sediment associated with pre-Wisconsin glaciations presumably filled the valley at one time but much of the valley was apparently eroded to bedrock at the onset of the Wisconsin Episode (Curry et al. 2001). During Wisconsin Episode glaciation of the Upper Midwest the valley was filled with outwash deposited from braided streams to an elevation of at least 480 ft above sea level as indicated by the maximum elevation of terraces and buried lacustrine deposits in tributaries in the area (Bergstrom and Walker 1956, Curry et al. 2001, Flock 1983, Grimley and Lepley 2004, Hajic 1998, Ollendorf 1993, Phillips 2004). Following the retreat of continental glaciers from the Midwest, the Mississippi River evolved from a braided to a meandering system at about 10,000 RCYBP (Hajic 1993, Blum et al. 2000). The meandering Mississippi River migrated across the central and western portions of the valley to its present location, depositing river sand, silt and clay unconformably on top of glacial sediments.

The major geomorphic features on the Granite City quadrangle are the abandoned meander belts (fig. 1). High-sinuosity meandering between about 8500 and 2400 RCYBP left prominent meander scars and related point bar, levee and backswamp features over a large portion of the Bottoms (fig. 1, table 1). At about 2400 RCYBP, the system evolved further from a high- to a low-sinuosity meandering regime (Booth and Koldehoff 1999, Hajic 1993) and has since occupied the western portion of the American Bottoms (gray dashed line in fig. 1). The low sinuosity meander belt is a few feet lower than the high sinuosity belt, possibly attesting to incision rather than aggradation during its construction. Even more recently the channel has been essentially straight. However, floodwaters periodically deposited fine sediment across much of the Bottoms prior to construction of levees in the past century.

The deposits that occur in the Mississippi Valley are mainly a mixture of waterlain clay, silt, sand, and gravel. Deposits are highly variable in the upper 50 feet because of the presence of the many former channels of the Mississippi River. There is a general coarsening trend with depth (see cross-sections), with sand and gravel outwash comprising the lower one-third to one-half of the sediment volume.

Glacial outwash
A medium to coarse sand with some fine sand and gravel (Henry Formation), interpreted as glacial outwash, is the oldest deposit still preserved in the valley in the Granite City quadrangle and lies unconformably on bedrock. The upper portion has been eroded and the unit is buried by post-glacial alluvium. The Henry Formation is thickest, about 60 feet, where bedrock is deeply incised near St. Louis (cross-section C–C′), but thins to the west and east as the bedrock surface rises (cross-section A–A′). It may contain some large erratic pebbles, cobbles, and boulders, particularly in the lower 15 feet. Within this quadrangle, Henry Formation is predominantly coarse to medium sand, but it fines eastward and upwards (Grimley et al., in preparation). Its deposition is related to glacial advances in the upper Midwest that did not reach the study area but caused aggradation in the Mississippi and Missouri Valleys. Occasionally, a reddish colored sand or gravel is noted in water wells or engineering borings at 90 to 100 foot depth which may represent the middle Wisconsin Episode outwash associated with Roxana Silt deposition. The upper boundary of Henry Formation is difficult to map because both texture and lithology grade gradually into the overlying post-glacial sediment.

Postglacial deposits
Postglacial deposits mapped in the American Bottoms comprise fine to medium sand (Cahokia Formation – sandy Mississippi Valley facies), silt to silty clay (Cahokia Formation – clayey Mississippi Valley facies), and disturbed ground. Sandy and clayey deposits near surface generally coincide with subtle changes in topography (compare surficial map to fig. 1) associated with the meander belts that comprise the major geomorphic features of the quadrangle. Topographic expression has been subdued because of vertical accretion of flood sediments in low areas of the meander scars. Surficial sediment distributions are often reflective of material to a depth of 10 to 60 feet (see cross-sections).

We concur with previous studies of the valley sediments (Bergstrom and Walker 1956, Willman and Frye 1970, Smith and Smith 1984) that sand-rich sediments (Cahokia Formation - sandy valley facies) are mainly postglacial channel and point bar sediments. These sands are predominantly fine to medium and are typically 25 to 50 feet thick. Fining-upwards sequences observed in detailed core descriptions of a Horseshoe Lake point bar at Horseshoe Lake State Park record the migration of river environments from channel sands through overbank fines. Lenses of fines within Cahokia sand may represent small backswamp lakes (cross-section B–B′). In the cross-sections, the boundary between Cahokia and Henry sand was estimated where the sand coarsens or at the base of abandoned meander clay plugs. In some water well logs and sample sets, clay layers were found to occur at about the base of the Cahokia Formation. In other cases, however, textural distinction between postglacial and glacial sand was not obvious from water well or engineering logs.

Clay and silt-rich sediments (Cahokia Formation, clayey Mississippi Valley facies) are interpreted as floodplain, backswamp, or abandoned channel deposits. Many oxbow lakes and abandoned meanders are clearly visible as present-day lakes or as patterns of surficial clay on the surficial geology map and on the shaded relief map (fig. 1). Abandoned channels in the high-sinuosity meander belt, most prominently Spring Lake, Edelhardt and Horseshoe Lake meanders (fig. 1), contain some of the thickest and finest Cahokia clay, as much as 40 feet thick. Because of their high sinuosity and low sand content of the fill, these abandoned meanders are interpreted to have formed by "neck cutoff" in which the river meandered so strongly that it completely curved back upon itself. During flood stages, a new shorter channel was ultimately cut at the neck and the former path was abandoned and left behind as an "oxbow" lake. Since abandonment, these deep lakes were filled in with thick deposits of silt and clay. Only Horseshoe Lake remains a lake today, whereas former lakes in the Edelhardt, Spring Lake and other meanders have been completed filled with fine-grained sediment.

In the subsurface, sandy and clayey facies of the Cahokia Formation commonly intercalate in swale fills and abandoned channels (cross-sections A–A′, D–D′). Slumping of relatively fine-grained channel walls onto coarser channel bars when channels were active caused some interfingering. During floods, fine to medium sand was generally deposited adjacent to channels to form ridges, and silt and clay were deposited farther from the channel in backswamp environments. After abandonment, the coarser overbank deposits overlapped and were later covered by finer overbank and lacustrine sediments of the channel fill. In particular, the boundary between the two channel belts (fig. 1) is a complex of sandy levee and crevasse splay deposits from the younger low sinuosity channels interfingering with silts and silty clays of fill of the abandoned high-sinuosity channels. Post-depositional erosion of sandy ridges into former channels and/or reoccupation of channels by the river may also have caused some of the interspersal of sediment.

Radiocarbon ages and superposition relationships among the former channels indicate they were abandoned between about 6000 and 2400 RCYBP (fig. 1, table 1). The Horseshoe Lake meander, the youngest high sinuosity meander on this quadrangle, was active from before about 4400 to about 2400 RCYBP (Gladfelter 1981, Hajic 1998). The basis for these estimates was a radiocarbon age of 3270 ± 80 (ISGS-563) from Horseshoe Lake clay plug sediments (30 foot depth) and from archeological constraints of Middle Woodland settlements on point bar complexes. An age of 8340 ± 250 (W-317) was noted by Willman and Frye (1970) on wood at 60 to 65 foot depth below left bank ridges and swales of Horseshoe Lake but its significance is not yet understood.

Soil profiles in the American Bottoms are relatively weakly developed because soil formation has occurred over a relatively short period. In addition, drainage classes are generally poor so B horizon soil development by translocation is inhibited.

Extensive areas of the American Bottoms have been significantly altered by human activity, from amerindian civilization to present. Urban areas including Monk's Mound, other archeological sites, and highway interchanges have received more than 5 feet of fill. Texture is variable from silt and sand to rubble, and most likely is derived from local sources.

Material Resources / Environmental Hazards

Sand and Gravel
Sand deposits, containing some gravel, as much as 125 feet thick (cross-section D–D′), lie predominantly below the water table in the Mississippi Valley and are a potential source of construction materials. Dredging operations for sand from the Henry Formation occurs in the eastern portion of the adjacent Monk's Mound quadrangle. The upper sand is relatively fine-grained and is primarily used for fill and for golf courses, but coarser, cleaner sand below 50 feet depth is usable by the construction industry (Goldman 1994). Some lignite in the gravel can be a problem for construction materials. On the Granite City quadrangle, the Henry Formation is relatively coarse, but is buried by extensive though relatively thin clayey facies of the Cahokia Formation. As well, urbanized land over more than half of the quadrangle could make extraction operations difficult.

Groundwater
Underlying the floodplain of the American Bottoms, thick, extensive sand and gravels of the Henry Formation are capable of yielding large quantities of groundwater (see cross-sections and Bergstrom and Walker 1956). The Cahokia Formation has limited groundwater potential because of the finer and discontinuous nature of sand bodies; however, small supplies are readily available (Bergstrom and Walker 1956). The potential for groundwater contamination is generally high in the floodplain because of the interconnectivity of the sand and gravel bodies and the discontinuous covering of silt and clay up to 40 feet thick.

Soil Erosion and Siltation
A heavy load of sediment is supplied to creeks draining the eastern bluffs (fig. 1) because friable loessal soils with low shear resistance are readily eroded by running water. Furthermore, the erosion of silt from uplands and siltation in bottomlands is thought to have been accelerated in historical times because of the onset of farming, construction, and deforestation in upland areas. Channelization has cut off alluvial fans below the bluffs where the streams would naturally deposit much of the sediment. Instead, the sediment is transported through channelized ditches to the American Bottom floodplain, and deposited rapidly in bottomland wetlands, lakes, and the ditches themselves. There are only a few active creeks in the Granite City Quadrangle, but the Cahokia canal requires periodic dredging to maintain its depth. The amount of siltation across the American Bottom can be appreciated by comparing much greater areas of open water on old topographic maps to the same areas more recent maps.

Table 1 Approximate age of geomorphic features

Landform		Date of Formation or Abandonment (radiocarbon years before present)	Surface Environment	Reference
Wood River Terrace		12,000–10,000	outwash, dunes	Hajic 1993; Flock 1983
"Featureless" low terrace		9,800–2400	erosional terrace, overbank	Hajic 1993
High sinuosity meander belt	McDonough Lake	10,600–9,800	abandoned channel	Rissing 1991
	Prairie Lake	5500	abandoned channel	White et al. 1984
	Edelhart Lake	Phase I: 5,500–4,500 Phase II: 4,500–3,600	abandoned channel	Rissing 1991
	Grand Marais	3280–3090	abandoned channel	Phillips and Gladfelter 1983
	Goose Lake	3180–3150	active channel	Gladfelter 1979
		2500–2300	abandoned channel	White et al. 1984
	Hill Lake	3500–3100	abandoned channel	White et al.1984
	Horseshoe Lake	2400 (abandoned)	lake, point bar	Gladfelter 1981; Hajic 1993, 1998; Booth and Koldehoff 1999
Low sinuosity meander belt		2,400–present	channel, levee, crevasse splay	Gladfelter, 1981; Hajic 1998; Booth and Koldehoff 1999

Mapping Techniques

Surficial Geology Map
This surficial geologic map is based in part upon soil series parent materials compiled from the Madison County and St. Clair County soil surveys (Goddard and Sabata 1982, Wallace 1978), but was modified based upon data obtained from field observations, drill cores obtained for this STATEMAP project, Illinois Department of Transportation (IDOT) borings, other engineering borings, and water well logs.

Cross Sections
The cross-sections portray the near-surface deposits as would be seen in a slice through the earth down to bedrock. The locations of the cross section lines are shown as thick black lines on the surficial map.

Data used for subsurface unit contacts (in approximate order of quality) are from studied outcrops, field descriptions of previous geologists (e.g., McKay 1977, 1979), stratigraphic test holes, engineering boring records (primarily IDOT), water well records, and coal test hole borings. Although the majority of data records are on the cross section lines, selected data points were projected from up to 1000 feet to the cross-section line. The projected data, indicated as dashed vertical lines on the cross-sections, were transferred to a point of similar elevation and similar geomorphology. Geologic unit contacts are dashed where the quality of sediment descriptions was less reliable or less detailed, particularly for some water wells and coal test borings.

All data shown in the cross-sections, with the exception of outcrop descriptions, are on file at the ISGS Geologic Record Unit and on the ISGS web site (www.isgs.uiuc.edu). Descriptions and interpretations of all data used in the cross-sections, including outcrops, can be obtained from the author.

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Cross Sections