Illinois Preliminary Geologic Map
IPGM Wood River-SG

Surficial Geology of Wood River Quadrangle

Madison County, Illinois

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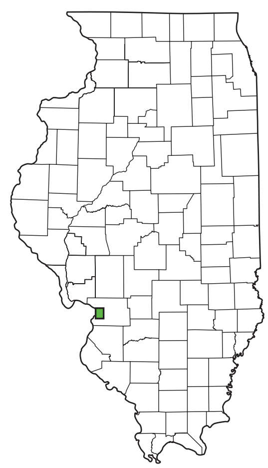
2005



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Introduction

The Wood River Quadrangle is located in southwestern Illinois about 10 miles northeast of St. Louis. This area is mostly contained within the American Bottoms, a large alluvial valley of the Mississippi River, containing up to 125 feet of water-laid clay, silt, sand, and gravel above bedrock. The eastern and northeastern portion of the quadrangle contains glaciated uplands blanketed by thick loess. The relatively steep bluff edge between the uplands and the American Bottoms has up to 150 feet of relief. West of the bluffs is an extensive terrace at an elevation of about 430 to 440 feet, locally referred to as the Wood River Terrace (fig. 1). Coalescing alluvial fans, composed of reworked deposits of the highly erodible loess and transported by bluffside creeks, occur between this terrace and the base of the bluffs. No bedrock exposures are known to occur in the quadrangle (F.B. Denny and J.A. Devera, personal communication, 2001), although some underground coal mines occur in the eastern uplands (Barrett 2001).

Methods

Map
This surficial geologic map is based in part upon soil series parent materials compiled from the Madison County Soil Survey (Goddard and Sabata 1982), 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. Data used for subsurface unit contacts (in approximate order of quality) include outcrops, as well as stratigraphic, engineering (primarily IDOT), water well, and coal borings. Although the majority of data 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 also dashed where the quality of sediment descriptions was less reliable or less detailed (e.g., some water well and coal borings. All subsurface boring data are on file at the ISGS Geological Records Unit. Descriptions and interpretations of boring and outcrop data is contained in an unpublished manuscript in the ISGS library (Grimley 2005).

Uplands (surficial deposits)

The upland area east and northeast of the bluff line can be characterized as a loess-covered Illinois Episode till plain that is highly dissected by Indian and Cahokia Creeks, as well as many small bluffside ravines. Illinois Episode glaciers are known to have crossed this area, just barely entering Missouri a few miles west of this quadrangle (Goodfield 1965; Willman and Frye 1970; Grimley et al. 2001).

Pre-Illinois episode deposits
Pre-Illinois episode deposits were observed to outcrop at only one locality (site 32f; Sec. 24, 5N, 9W), but occur in the subsurface in numerous borings. At outcrop 32f, a borrow pit for construction of the I-255 extension, 10 feet of an orange-brown to gray silty clay loam diamicton (till) was exposed. The presence of a reddish brown silty clay Yarmouth Geosol (a buried interglacial soil) in its upper few feet, displaying strong weathering features, as well as the color and texture of the till, imply a correlation with the Banner Formation. High calcite to dolomite ratios in this till are also consistent with the Banner

Formation and probably reflect an eastern or northeastern source for glacial ice (Willman and Frye 1970). Based on several engineering borings in the northeast portion of the quadrangle (Sec. 23 and 25, 5N, 9W), the Banner till has a higher moisture content (w ~ 19–25 %) than the overlying, sandier Illinois Episode till (w ~ 14–20 %).

The Banner Formation is composed primarily of till but, in some areas, may include outwash sand, fine-grained lake deposits, and preglacial alluvium (boring 26506; Sec. 29, T5N, R8W). In most areas, the Yarmouth Geosol was likely eroded by advancing ice during the subsequent Illinois Episode. The Banner Formation occurs in the subsurface below the 475-foot elevation and is especially common in buried bedrock valleys (up to 60 feet thick), where protected from later glacial advances and erosional processes. One speculated occurrence of Banner Formation is indicated in cross section D-D´ where a bedrock valley likely exists underneath the present-day Indian Creek valley. The Banner Formation is also likely present in Section 5, T4N, R8W, based on the several subsurface engineering borings. The elevation of the top of the Banner Formation generally decreases from northwest to southeast towards the Indian and Cahokia Creek valleys, probably reflecting the bedrock topography and/or enhanced erosion by Illinois Episode ice flow in valleys. Previous studies (McKay 1979) and recent mapping (*e.g.*, A. Phillips, 2004) to the immediate north, east, and southeast have shown that pre-Illinois episode deposits tend to occur in bedrock lows, typically below an elevation of 475 feet in western Madison County.

Illinois Episode deposits

Silt loam to loam diamicton with sand and gravel (Glasford Formation), altogether as much as 60 feet thick, compose the bulk of the Illinois Episode deposits. The Glasford diamicton, interpreted as mainly till, is in places overlain by, underlain by, or interspersed with up to 40 feet of outwash sand and gravel (engineering borings in Section 5, T4N, R8W). This outwash was likely deposited by glacial meltwaters in valleys upon advance or retreat of glacial ice to the area. Sand and gravel in this unit seems to thicken in areas proximal to the Indian and Cahokia Creek valleys, which may have been drainage sluiceways for glacial meltwater. In several exposures of the Glasford Formation, local Pennsylvanian shale and sandstone pebbles, as well as spruce wood fragments are common in the unweathered, unoxidized till. The Glasford and Banner Formations are separated by the Yarmouth Geosol which formed into the upper Banner Formation; however, in the absence of this soil (due to erosion), these units may be delineated fairly reliably because of the sandier (loamy) texture, higher dolomite content, and lower moisture content of the Glasford Formation.

Glasford till or outwash is commonly overlain by 5 to 10 feet of weathered silt loam, silty clay loam, and loam. This unit, known as the Teneriffe Silt, is interpreted as windblown silt (loess) and/or lake sediments that were deposited following the retreat of the Illinois Episode ice margin to the northeast. The upper few feet of Teneriffe Silt contains the weathering profile of the Sangamon Geosol.

Wisconsin Episode deposits

Windblown silt (loess), up to 80 feet thick, but typically 15 to 60 feet thick, blankets older deposits on uplands in the eastern map area. The loess was derived from windswept outwash in the broad combined Mississippi-Missouri valley. With prevailing winds from the west to northwest, the thickest loess was deposited on uplands in the southeastern portion of the quadrangle, adjacent to the widest portion of the American Bottoms. The loess deposits, consisting of the Peoria and Roxana Silts, thin exponentially to the east and north of the bluff edge. The older Roxana Silt is distinctively pinkish brown, consistently thinner and has slightly more sand, coarse silt, and clay compared to the yellow brown Peoria Silt (McKay, 1977). However, when thicker than about 10 feet, the Roxana Silt reveals a tan middle zone that has the yellow brown hue of Peoria Silt. In areas of thick loess, both units contain locally abundant terrestrial gastropods (0.2 to 2.0 cm in diameter). 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).

Stratified silty clay to silt deposits (Equality Formation) of the last glaciation occur in terraces of large tributaries to the Mississippi River valley, notably the Indian and Cahokia Creek valleys. The Equality Formation was deposited in a slackwater lake environment when high water levels and sediment accumulation in the Mississippi Valley caused lakes to form in adjacent tributaries to an elevation as high as 480 feet (highest terrace elevation). Based on engineering boring data, the Equality Formation also occurs beneath the more texturally variable Cahokia alluvium in the Indian and Cahokia Creek valleys. The Equality Formation is readily distinguished from Glasford or Banner till in these boring logs by its higher moisture content (> 25 % in lake deposits), lower unconfined compressive strength (typically < 1.5 tons/ft^2), and lack of coarse sand and gravel.

Postglacial Deposits

In most tributary valleys, postglacial stream sediment (Cahokia Formation) consists of up to 30 feet of silt with silty clay beds and sand and gravel lenses. This sediment is thickest in large valleys such as those of Indian and Cahokia Creek. Because of the high erodibility of loess deposits, the Cahokia Formation (in upland tributaries) has a large component of redeposited Peoria and Roxana Silt. Sandy or gravelly layers occur as lenses or as layers near the base of the unit in the larger valleys.

On uplands, the modern soil, typically a native forest soil (Alfisol), has developed into the Peoria Silt in its upper 3 to 5 feet. In addition, loess deposits have been leached of carbonates to depths of about 5 to 15 feet. Often, these carbonates reprecipitate at lower depths into irregularly shaped nodules or concretions.

American Bottoms (surficial deposits)

Filling and excavation of the Mississippi River valley likely occurred several times during the Quaternary Period. During the last glaciation (Wisconsin Episode), the American Bottoms was filled with outwash to about 480 feet above sea level based on tributary terrace elevations (Grimley, 2002). Following the retreat of sediment-rich continental glaciers from the Midwest, the Mississippi River evolved from a braided to a meandering system between about 10,000 and 8500 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 sand, silt, and clay unconformably on top of the outwash. 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). However, flood waters periodically deposited fine sediment across much of the Bottoms prior to construction of large levees in the past century.

Deposits in the Mississippi River valley, consisting of mixtures of water-laid clay, silt, sand, and gravel, are highly variable in the upper 50 feet because of many former channels of the Mississippi River. There is a general coarsening trend with depth (see cross sections), with outwash (sand with gravel) typically comprising the lower one-third to one-half of the sediment volume. In a few places, subsurface

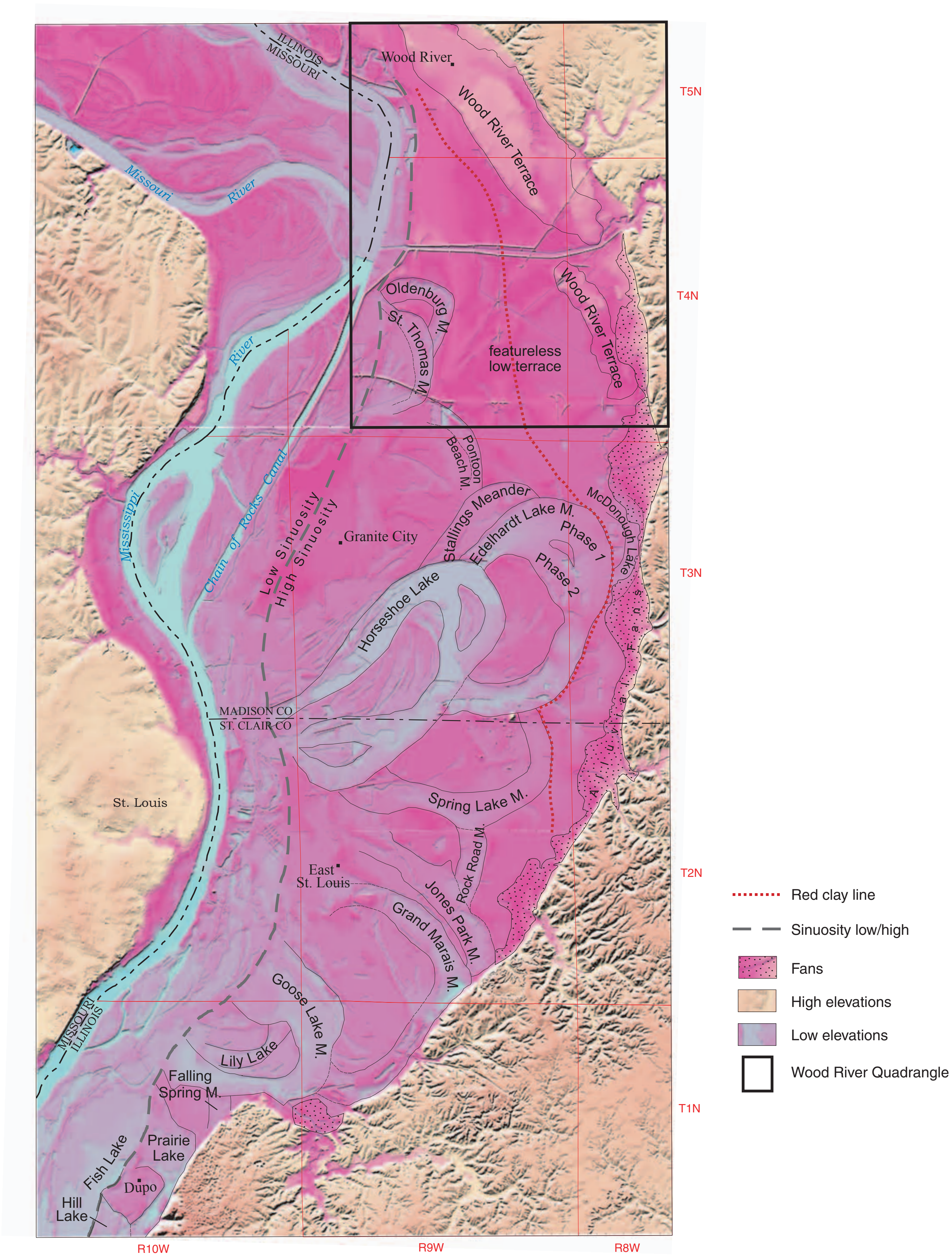

Figure 1 Physiographic (shaded relief) map of the American Bottoms in Madison and St. Clair Counties, Illinois.

Table 1 Approximate age of geomorphic features in figure 1.

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 2500-2300	active channel abandoned channel	Gladfelter 1979 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

engineering borings indicate an erosional lag of Glasford till (or possibly Banner till) preserved underneath thick alluvial sediments. The underlying bedrock consists mainly of limestone (western areas) or shale (eastern areas).

Glacial outwash

Outwash deposits in the American Bottoms, known as the Henry Formation (Wisconsin Episode), vary texturally from predominantly fine sand underneath the Wood River Terrace (especially the upper 50 feet) to predominantly medium and coarse sand, with some fine sand and gravel, underneath postglacial alluvium in the southern and western portions of the quadrangle. In both areas, the Henry outwash is related to glacial advances in the upper Midwest that did not reach the study area, but provided sediment to major river valleys. In the Wood River Terrace, the Henry Formation is as much as 145 feet thick, and it may include several periods of sedimentation and erosion. Fine sand is common in the terrace, perhaps because it was more protected during most of its history and experienced slower moving meltwaters and more limited erosion. Henry outwash in the subsurface south and west of the terrace may contain large erratic pebbles, cobbles, and boulders in its lowest 15 feet. In some parts of the American Bottoms, a reddish colored sand or gravel was noted in water well or engineering borings at a depth of 90 to 100 feet that may represent middle Wisconsin Episode outwash associated with Roxana Silt deposition. Pre-Wisconsin episode outwash, associated with early glaciations, presumably once filled the valley, but were likely eroded by the Mississippi River during intervening interglacial episodes. Outwash deposits tend to thin within 0.5 miles of the bluff edge as the bedrock surface rises.

Red clay layer (glacial / postglacial boundary)
In the easternmost two to three miles of the American Bottoms in this quadrangle (east of the red dashed line on the map and fig. 1), thin red silty clay beds occur below gray overbank silty clay (see thick red lines on cross sections). The red clay, typically 1–2 feet thick, was likely derived from the Lake Superior region, perhaps from a glacial lake outburst, and was deposited between about 9900 to 9500 RCYBP in the region (Flock 1983, Hajic 1993). Wood found in organic-rich gray clay at about the 23-foot depth immediately above the red clay has an age of 9259± 200 (ISGS-1559) at a site west of McDonough Lake several miles to the south (Higgins 1990). The red clay approximately separates postglacial clayey sediments (Cahokia Formation) from underlying glacial outwash (Henry Formation). Based on fifteen observations of the red clay in the subsurface in the Monks Mound and Wood River Quadrangle, the top of the clay occurs between elevations of 395 and 403 feet above sea level. Areas that contain the red clay bed are interpreted as areas over which the postglacial Mississippi River has never meandered; however, the beds are buried by postglacial overbank deposits.

Postglacial deposits
Postglacial deposits mapped in the American Bottoms consist of fine to medium sand (Cahokia Formation - sandy facies), silt to silty clay (Cahokia Formation - clayey facies), silty to loamy alluvial fan deposits (Cahokia Formation – fan facies), and disturbed ground. Near-surface sandy and clayey deposits generally coincide with subtle changes in topography (compare surficial map to figure 1). During floods, fine to medium sand was generally deposited adjacent to channels to form ridges, and silt and clay was deposited in backswamp environments. In the subsurface, sandy valley deposits commonly interfinger with and are overlain by silty clay to silty clay loam in swale fills and abandoned channels of the Mississippi River (see cross sections). Multiple depositional environments have occurred at any given location as the Mississippi River meander belt has shifted through time. Erosion and slumping of deposits from raised bars has further added to the sedimentological complexity.

Sand-rich sediments west of the Wood River Terrace are mainly postglacial channel and point bar sediments (Cahokia Formation - sandy facies), as was also noted by Bergstrom and Walker (1956). These sands are predominantly fine to medium grained and are typically 50 to 65 feet thick. Lenses of fine-grained deposits within Cahokia sand may reflect 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 borings and sample sets, clay layers were found to occur at about the base of the Cahokia Formation. In some cases, textural distinction between glacial and postglacial sand was not obvious from water well or engineering boring logs.

Clay and silt-rich sediments (Cahokia Formation, clayey 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). In some areas, topographic expression of meander scars is subdued due to vertical accretion of overbank flood sediments; partial burial of meander scars in this quadrangle was noted by Hajic et al. (2000). Abandoned channels in the high-sinuosity meander belt (fig. 1), contain some of the thickest and most fine-grained Cahokia clay, as much as 55 feet thick. Clay has also filled in other lows areas, such as in swales between point bar ridges in the southwestern part of the quadrangle. Overbank Cahokia clay has also been deposited over much of the middle portion of the map.

Alluvial fan deposits (Cahokia Formation – fan facies), containing silty redeposited loess up to 25 feet thick (cross section A–A′), extend out onto the valley where large creeks emerge from the bluffs onto the Mississippi River floodplain. Silty sediment was deposited where the gradient of the creeks was reduced and the creeks once split into many distributaries prior to channelization for flood control. The upper few feet of sediment in the fans may have been deposited in historical time (Booth and Koldehoff 1999). Soil profiles in the American Bottoms west of the Wood River Terrace are much less developed than those on uplands because of poor drainage and less soil development time for the younger deposits. Significant areas of disturbed ground are mapped 1.) on the Wood River Terrace where oil refineries are widespread, 2.) along the many interstate interchanges and levees, 3.) at a landfill adjacent to Cahokia Creek, 4.) where other areas of fill (some of unknown origin) are present.

Economic Resources / Environmental Hazards

Sand and Gravel
Extensive sand deposits, containing some gravel, in the Mississippi Valley have great potential as a source of construction materials in this quadrangle. However, much of the cleaner medium to coarse sand that is valuable for the construction industry (Goldman 1994) is buried by 40 feet or more of fine sand, silt and clay. Dredging for sand from the Henry Formation is currently in operation just south of this quadrangle in the eastern portion of the Bottoms near McDonough Lake. Here, the upper sand is more fine-grained and is primarily used for fill and golf courses. The sand coarsens with depth, and below the 50 feet depth, the cleaner sand is used in construction. Some lignite in the gravel can be a problem for construction materials.

Groundwater
Underlying the floodplain of the American Bottoms are thick, extensive sand and gravels of the Henry Formation that are capable of yielding large quantities of groundwater (cross sections; Bergstrom and Walker 1956). The Cahokia Formation, overlying the Henry, 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 inter-connectivity of the sand and gravel bodies and the discontinuous covering of silt and clay (0–50 feet thick).

Extensive sand and gravel deposits suitable for groundwater development are more limited on uplands. Here, bored wells, completed in the loess and thin till deposits, are common. There is potential for limited groundwater supply in sand and gravel lenses in the Glasford Formation, particularly in the vicinity of Indian Creek. Additionally, some bedrock aquifers are utilized, but wells drilled into sandstone and limestone generally yield low groundwater supply. The contamination potential of upland aquifers is low where loess and till deposits are thickest, but rises to moderate where surficial materials are thin or sandy material is within 25 feet of the surface (Berg et al. 1984).

Mass Wasting
Erosion, undercutting and slumping of thick loess deposits at bluff edges are a potential hazard (Krumm 1984; Killey et al. 1985). Slumps, rotational failures in sediment along a curved slip surface, commonly occur in this area where groundwater saturates loess above the clayey and relatively impervious Sangamon Geosol or Glasford till (Krumm 1984). These slumps predominantly occur within loess

deposits and have been observed along many creek cutbanks and steep bluffs. Slope failure and slumping, in large part due to site excavations and heavy precipitation, were studied in detail at a site along Bunkum Road in the French Village Quadrangle (Krumm 1984).

Soil Erosion and Siltation

Steep slopes along ravines and along the bluffs are subject to severe soil erosion by running water due to the friable nature of loessal soils, which have a low shear resistance. Runoff during rain storms can quickly enlarge rills and gullies, accelerating erosion as water is channeled into the growing drainage system. Eroded sediment is transported from steep upland creeks through channelized ditches to the American Bottom floodplain, thereby causing rapid siltation in wetlands, lakes, and swamps. Due to the channelization of creeks for flood control, sediment is no longer deposited in alluvial fans as it once did during the previous several thousand years. Bottomland siltation has been further accelerated in historical times because of the onset of farming, construction, and deforestation in upland areas. In the upper portion of the Cahokia Formation along small tributaries, one occasionally finds 5 to 10 feet of historical silt deposits, containing buried glass bottles, cans, or brick fragments that document rapid deposition during the last century.

Mine-out-area Subsidence

Some areas of uplands, particularly in the southern portion of the quadrangle, have been undermined for extraction of the Herrin (#6) coal in the past century (Barrett 2001). Land subsidence in mined out areas can be a serious problem for developers and construction projects.

Acknowledgments

Thanks to all of the landowners who allowed us access to their property and to the consulting companies that provided us with important data for this project. Individuals at the Illinois Department of Transportation and Madison County Highway Department were of great assistance in providing detailed boring locations and descriptions.

This research was supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program under USGS award number 00HQAG0151. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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