

Geologic Mapping of Near-Surface Sediments in the Northern Mississippi Embayment

Prepared by
Kentucky Research Consortium for Energy and Environment
233 Mining and Minerals Building
University of Kentucky, Lexington, KY 40506-0107

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Mississippi Embayment**

Presented by Josh Sexton
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Abstract:

The Jackson Purchase region of western Kentucky consists of Coastal Plain sediments near the northern margin of the Mississippi Embayment. Within this region is the Paducah Gaseous Diffusion Plant (PGDP), a uranium enrichment facility operated by the US Department of Energy. At PGDP, a Superfund site, soil and groundwater studies have provided subsurface lithologic data from hundreds of monitoring wells and borings. Despite preliminary efforts by various contractors, these data have not been utilized to develop detailed stratigraphic correlations of sedimentary units across the study area. In addition, sedimentary exposures along streams in the vicinity of PGDP have not been systematically described beyond the relatively simple geologic quadrangle maps published by the US Geological Survey in 1966–67. Our study integrates lithologic logs, other previous site-investigation data, and outcrop mapping to provide a near-surface stratigraphic framework model of the PGDP area. Preliminary findings suggest that previous ideas about gross heterogeneity of the Holocene and Pleistocene sediments composing the Regional Gravel Aquifer of the area may not be correct. Moreover, the lateral continuity of the Mounds Gravels and the Metropolis Formation may be greater than previously described. These findings may result in a more realistic model of groundwater flow beneath the site. In addition, the findings may be useful for assessing local amplification of earthquake ground motion in near-surface sediments.



Methods

- Formed a digital database compiling lithologic logs from borings and wells installed by PGDP, Tennessee Valley Authority (TVA), UK, and USGS
- Investigated surficial geology where exposures could be found, dominantly along creeks and borrow pits (**Site map**)
 - Documented exposures by measuring sections of outcrop, noting geology, and compiling a photographic database (**Image 1**)
 - Collected sediment samples for geologic age dating using Optically Stimulated Luminescence (OSL) (**Image 2**)
 - Collected clast orientation data along exposures where a fabric was observed
- Surveyed contact elevations of stratigraphic units cropping out along Little Bayou Creek and Bayou Creek (**Image 3**)
- Examined closely spaced, shallow sediment cores collected during a paleo-seismic investigation (**Site map**)
- Conducted a field trip with regional experts to discuss site geology and depositional history
- Created stratigraphic cross-sections, isolith maps, and isopach maps of the study area

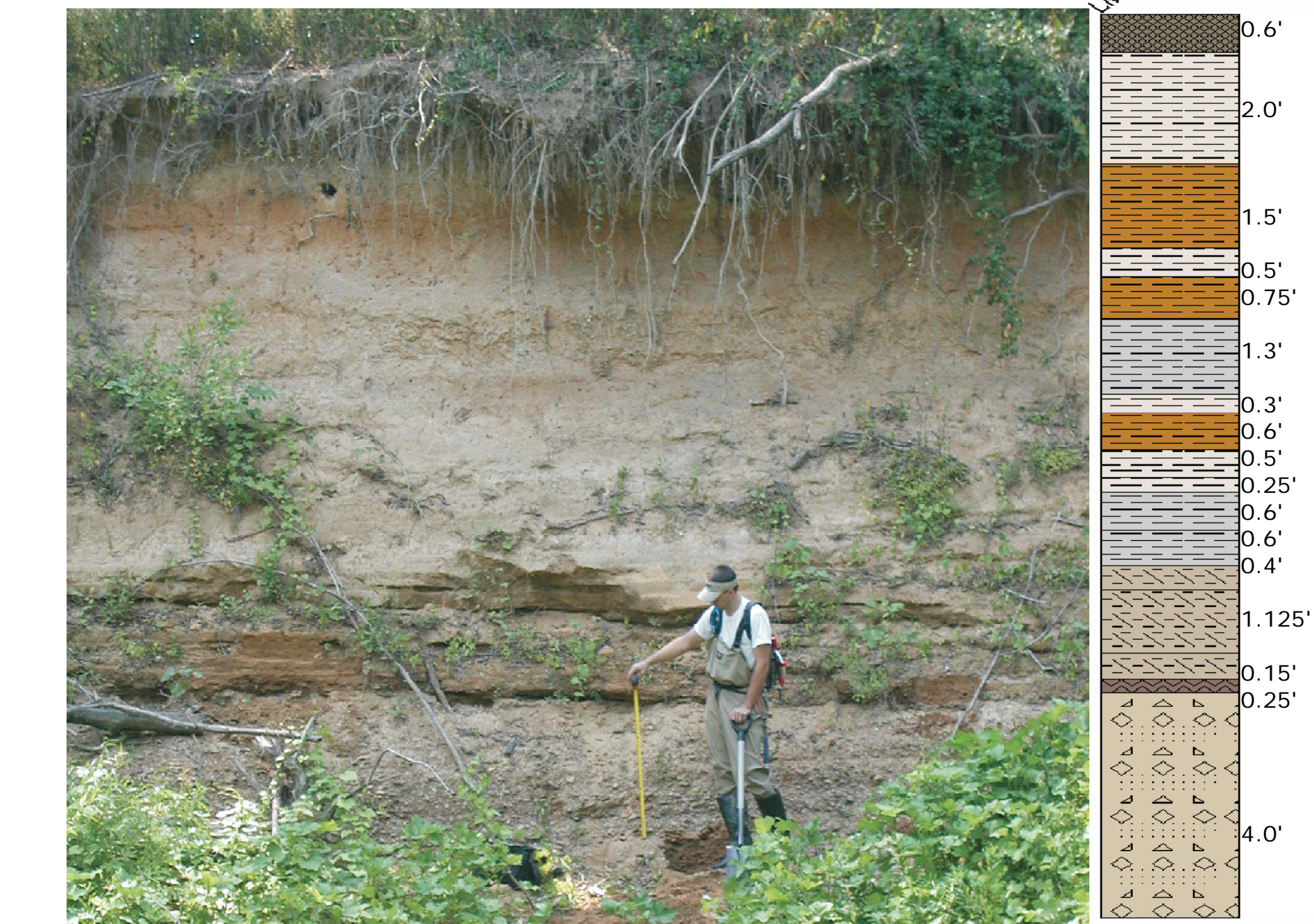
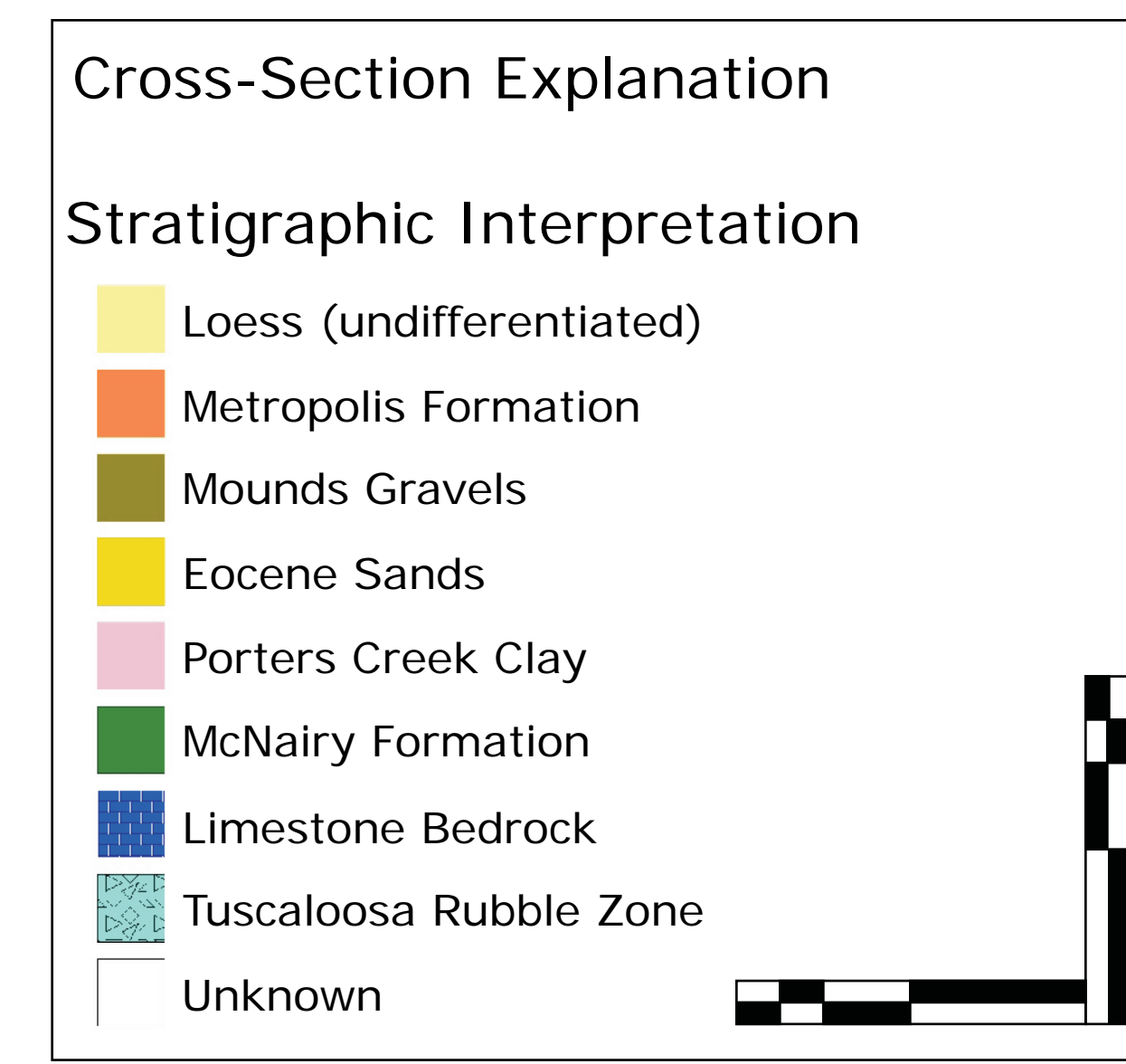
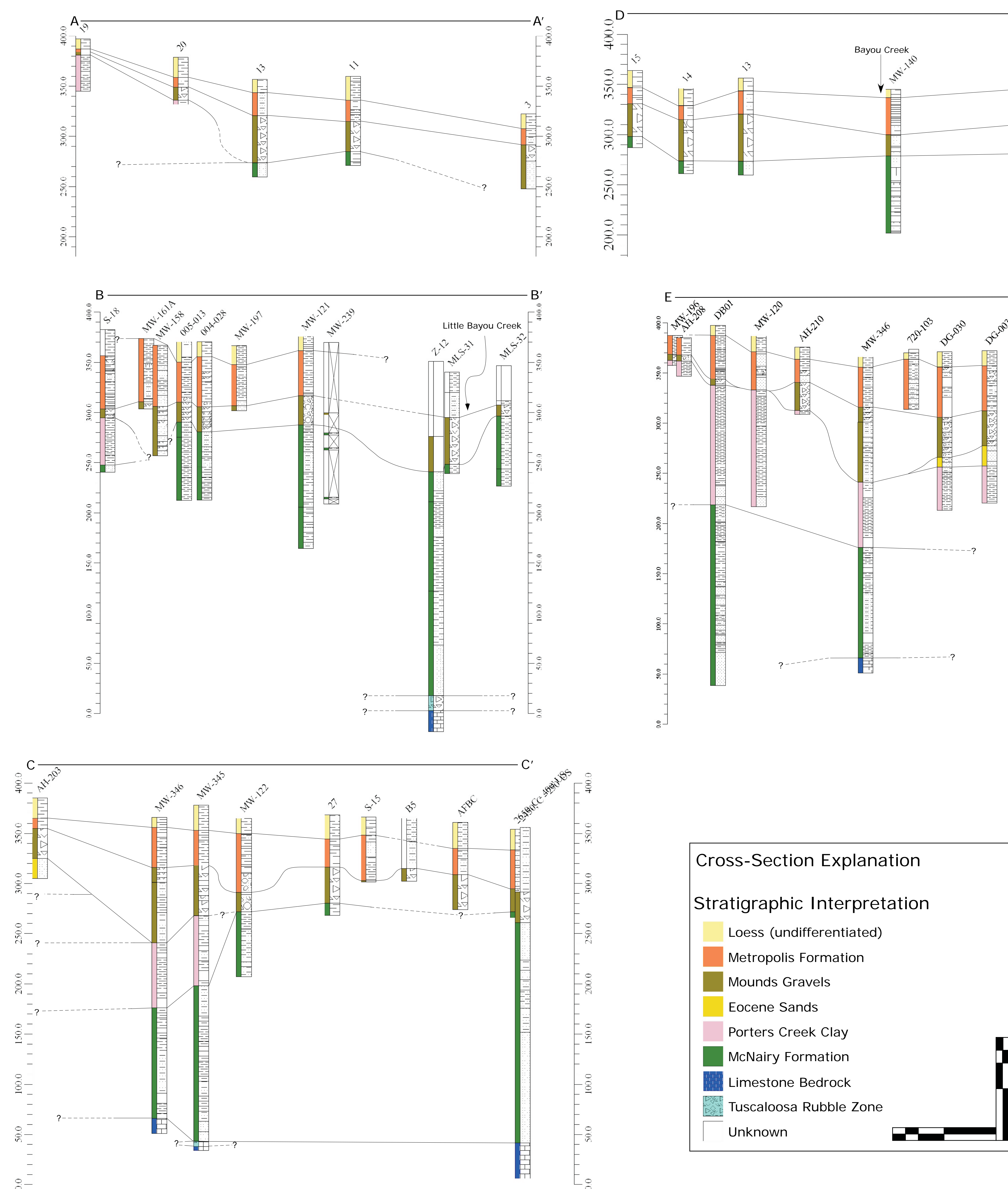


Image 1: Measured section location along Little Bayou Creek



Image 3: Surveying elevation of Mounds Gravel contact along Little Bayou Creek



Image 2: OSL sampling location along Little Bayou Creek



Image 4: Paleo-liquefaction feature noted along Bayou Creek

Interim Results

- The Mounds Gravel and Metropolis Formation names can be applied respectively to the informal unit names Continental Deposits and Quaternary silt and sand at the site
- Mounds Gravel exposed along Little Bayou Creek and Bayou Creek in the northern portion of the study area were previously unmapped and may be pathways for groundwater discharge to the creeks
- Mounds Gravel appear to form a continuous sheet deposit north of the Ancestral Tennessee River terrace slope interpreted by Jacobs (1997), with areas of channel scour that could have created preferential groundwater flow paths
- The Metropolis Formation appears to be laterally traceable on the order of 10 to 1000 feet, but does not exhibit traceability beyond this scale because of the small order bedforms associated with a sluggish fluvial depositional system (Nelson et al., 1999)
- Seismic deformation of Quaternary sediments in the study area appears possible from observations noted in previous site investigations, surficial geologic mapping (**Image 4**), borehole stratigraphic unconformities, and evidence presented in unpublished maps of the Joppa 7.5-minute quadrangle produced by the Illinois State Geological Survey

References

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