Geology of the Watson 7.5-Minute Quadrangle, LA

Louisiana Geological Survey

Introduction, Location, and Geologic Setting

The Watson 7.5-minute quadrangle lies in the southeastern portion of the south Louisiana coastal plain (Figures 1, 2), in the drainage basin of the Amite River. The axis of the subsurface lower Cretaceous shelf edge (Toledo Bend flexure), which trends west-northwest to east-southeast, lies directly beneath the study area. The surface comprises strata of the Pleistocene Hammond alloformation, Prairie Allogroup, characterized by a preserved depositional surface with indistinct constructional topography. The Hammond is covered by late Pleistocene Peoria Loess that is generally thin, with the 1-m thickness contour traversing the quadrangle along a nearly north-south trend (Figure 2), and is incised by Holocene undifferentiated alluvium of the Amite River and its tributaries.

The units recognized and mapped in this investigation are summarized in Figures 3 and 4.

Previous Work

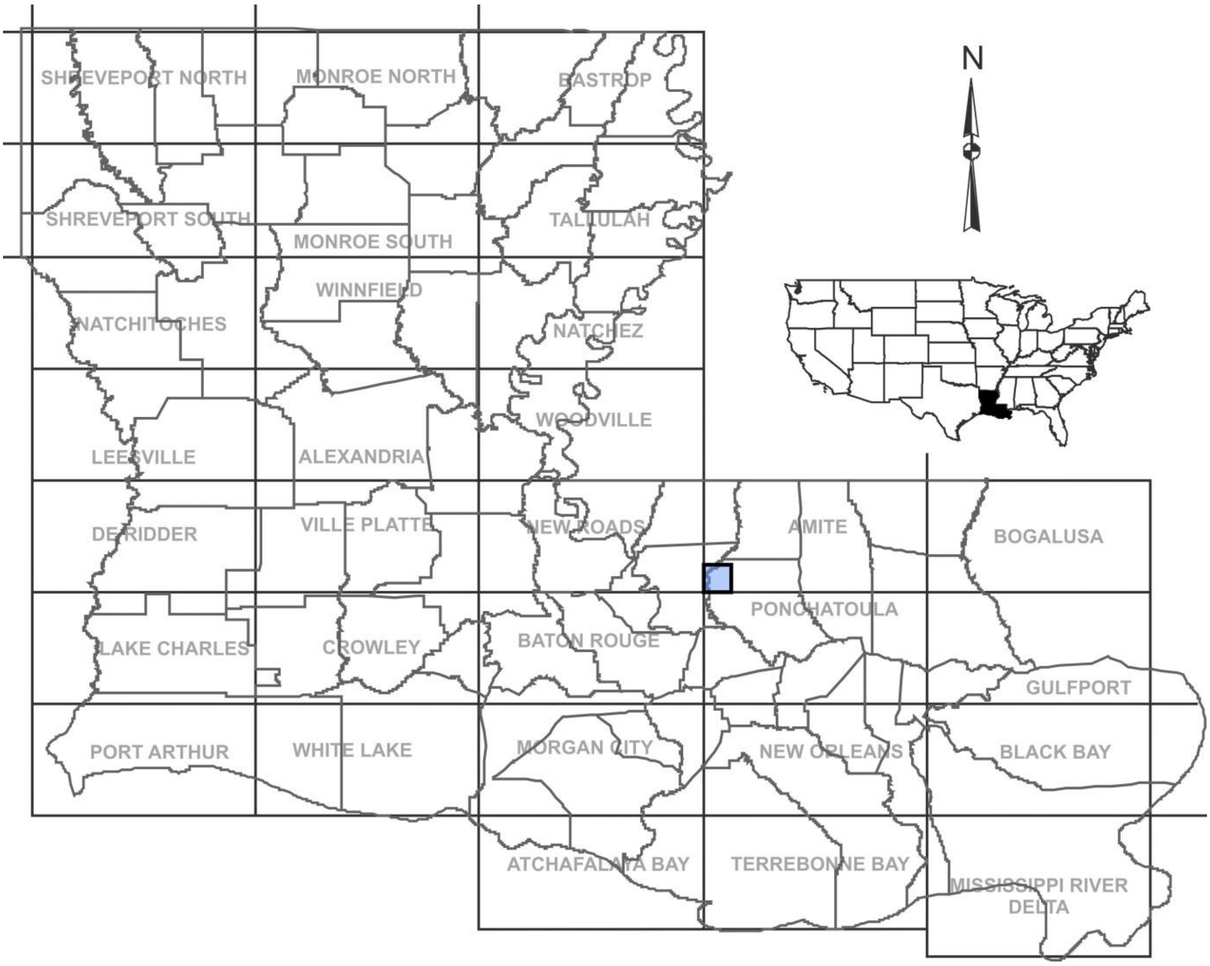
The Watson quadrangle covers portions of East Baton Rouge and Livingston parishes (Figures 1, 2). It lies at the southwestern corner of the Amite 30 × 60 minute quadrangle, the surface geology of which was compiled at 1:100,000 scale by McCulloh et al. (1997) and digitally recompiled by McCulloh and Heinrich (2008), both with STATEMAP support, and later prepared as a Louisiana Geological Survey (LGS) lithograph (McCulloh et al., 2009). The original 1996–1997 investigation benefited from a drilling component by which the most problematic map-unit assignments were tested with a total of 15 holes drilled with a Giddings hydraulic probe. Prior to this compilation, Self (1980, 1986) mapped the surface geology of the uplands of all of Louisiana's "Florida" parishes in southeastern Louisiana, though at 1:250,000 scale, and Autin and McCulloh (1991) mapped the surface geology of East Baton Rouge Parish at 1:24,000 scale.

The original 1996–1997 investigation of the Amite 30 × 60 minute quadrangle also revealed several previously unrecognized south-facing escarpments with 2 to 3 m (7 to 10 ft) of relief and west-northwest trends near the south edge of the Amite 30 × 60 minute quadrangle. West-northwest-striking faults have been mapped in the subsurface downdip of many of these escarpments, with displacements all less than 500 ft at depths of 15,000 ft or greater (Geomap Company, 2002), and the surface escarpments are interpreted to represent the fault-line scarps of reactivated growth faults of the Baton Rouge fault system (McCulloh and Heinrich, 2012), which primarily lies farther to the south. One of these interpreted surface faults courses a short distance into the eastern Watson quadrangle from the east-southeast (Figure 2).

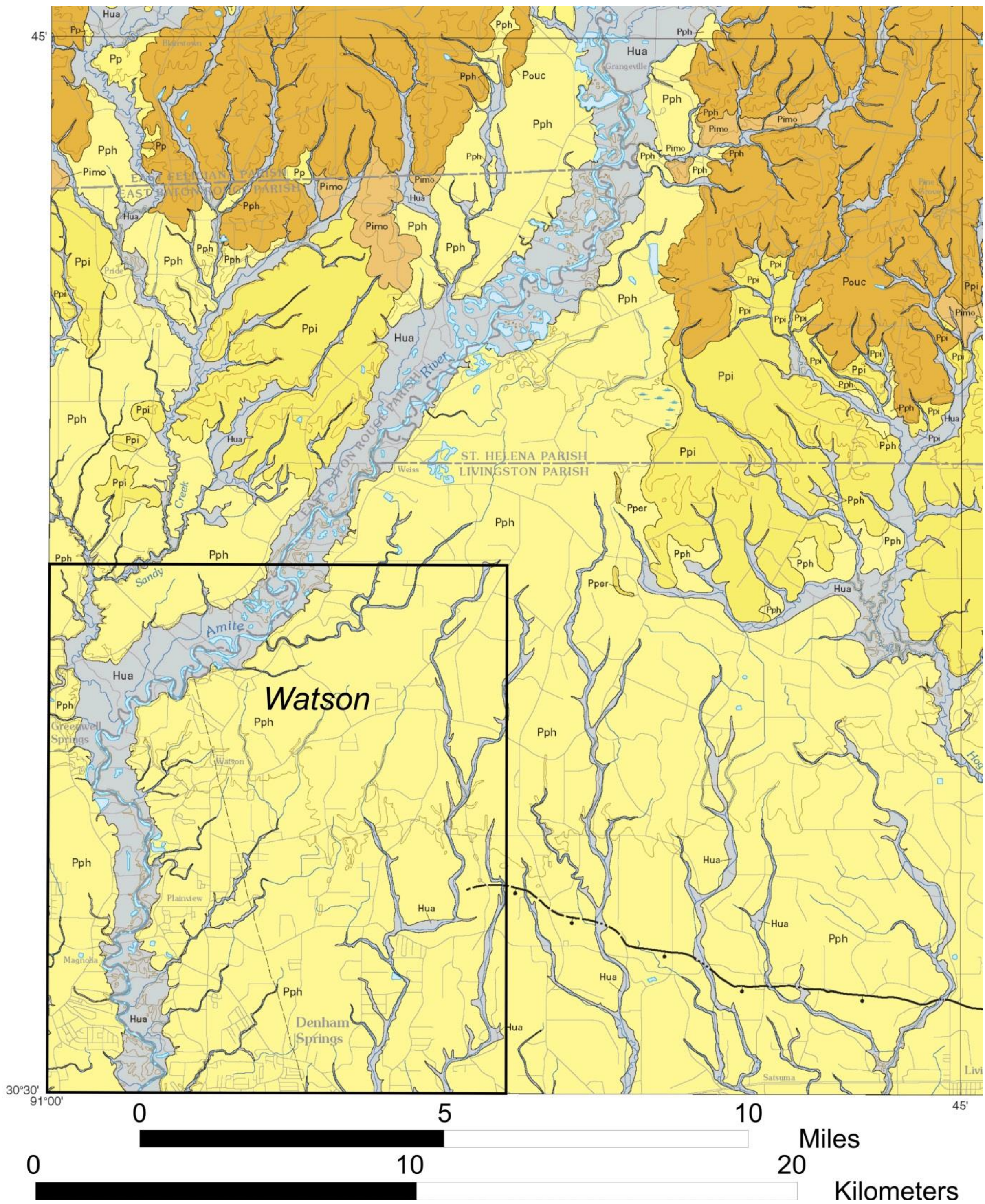
Tomaszewski et al. (2002) detailed groundwater conditions pertinent to the Southern Hills aquifer system, and Van Biersel and Milner (2010) summarized its distribution, recharge area, proportions of water-use categories, and pumpage rates.

Methods

The investigators reviewed legacy information and made new interpretations consulting remotely sensed imagery (comprising aerial photography, LIDAR DEMs, and other sources) and soils databases published by the Natural Resources Conservation Service (NRCS) to develop a draft surface geology layer for the study area. Field work was conducted to test the subsoil with hand-operated probes and examine and sample the texture and composition of the surface-geologic map units. Field observations were then synthesized with the draft surface geology to prepare an updated integrated surface geology layer for the 7.5-minute quadrangle.



1. Location of Watson 7.5-minute quadrangle, southeastern Louisiana.



2. Surface geology of Watson quadrangle and vicinity (adapted from McCulloh et al., 2009). (**P$_o$uc**, Citronelle Formation, Upland allogroup (Pliocene); **Pimo**, Montpelier alloformation, Intermediate allogroup (Pleistocene); **Ppi**, Irene alloformation, Prairie Allogroup (Pleistocene); **Pph**, Hammond alloformation, Prairie Allogroup (Pleistocene); **Pp**, Prairie Allogroup, undifferentiated (Pleistocene); **Hua**, Holocene undifferentiated alluvium.)

QUATERNARY SYSTEM

HOLOCENE

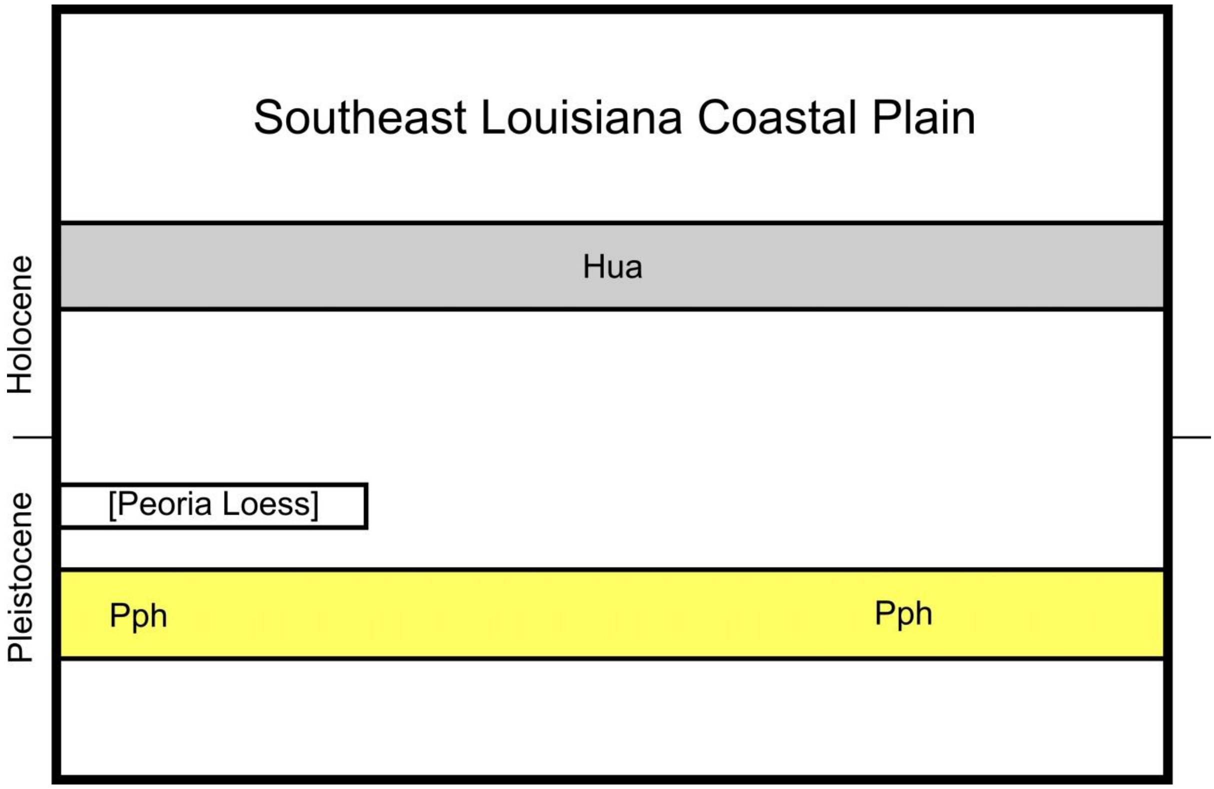
Hua Holocene undifferentiated alluvium

PLEISTOCENE

LOESS
[pattern] Peoria Loess

PRAIRIE ALLOGROUP
Pph Hammond alloformation

3. Units mapped in the Watson 7.5-minute quadrangle.



4. Correlation of strata mapped in the Watson 7.5-minute quadrangle.

Allostratigraphic Approach to Pleistocene Unit Definitions

In the late 1980s the LGS had begun exploring the application of allostratigraphic concepts and nomenclature to the mapping of surface Plio–Pleistocene units (e.g., Autin, 1988). In Louisiana these units show a series of geomorphic attributes and preservation states correlative with their relative ages, which eventually led LGS to conclude that allostratigraphy offers an effective if not essential approach to their delineation and classification (McCulloh et al., 2003). The Plio–Pleistocene strata for which allostratigraphic nomenclature presently has value to LGS all are situated updip of the hinge zone of northern Gulf basin subsidence, and show a clear spectrum of preservation from pristine younger strata to trace relicts and remnants of older strata persisting in the coastal outcrop belt and on high ridgetops in places updip of it. Allounit nomenclature has figured heavily in the STATEMAP-funded geologic mapping projects of the past two decades because Quaternary strata occupy approximately three-fourths of the surface of Louisiana. The surface of the Watson quadrangle consists exclusively of Quaternary strata, which dictated a continuation of this practice for this investigation.

Hammond alloformation, Prairie Allogroup (Pleistocene)

The Prairie Allogroup is a collection of late Pleistocene depositional sequences of alloformation rank (Autin et al., 1991; Heinrich, 2006). The sediments of the Prairie Allogroup accumulated within a diverse suite of coastal-plain settings, i.e., fluvial (meander-belt and backswamp), colluvial, possibly eolian, estuarine, deltaic, and shallow-marine environments. These largely fine-grained sediments accumulated over a considerable part of the late Pleistocene (Sangamon to Wisconsin) (Autin et al., 1991; Otvos, 2005; McCulloh et al., 2003; Heinrich, 2006).

The surface of the Prairie Allogroup forms a coastal terrace along the northwest coast of the Gulf of Mexico from a point about 110 km (~70 mi) south of the Rio Grande within Mexico over to at least Mobile Bay, Alabama. This surface is the lowest continuous terrace lying above Holocene coastal and flood plains. This relatively undissected terrace exhibits constructional topography that is more poorly preserved than exhibited by terraces of the Deweyville Allogroup and lacking on older Pleistocene surfaces. It comprises multiple stratigraphic units of alloformation rank (Saucier and Snead, 1989; Autin et al., 1991; Dubar et al., 1991; Winker 1990).

Within the Florida Parishes, the youngest and most extensive surficial unit is the Hammond alloformation of the Prairie Allogroup (Heinrich, 2006; McCulloh et al., 2009). Its name is derived from Hammond, Louisiana and the Hammond terrace of Matson (1916). It is an allostratigraphic unit that forms part of the Prairie Allogroup. The surface of the Hammond alloformation is a coast-parallel terrace that is 16–40 km (10–25 mi) wide and extends from the eastern valley wall of the Mississippi River alluvial valley eastward across the Florida Parishes and the Pearl River into Mississippi. It is the lowest and best preserved of the Pleistocene terraces found between the Mississippi and Pearl rivers. In the Florida Parishes it exhibits moderately to poorly preserved relict constructional landforms. These landforms include relict river courses, meander loops, ridge-and-swale topography, coastal ridges, and beach ridges. In some areas, they include valley walls and flood plains of entrenched valleys. Overall, the surface of the Hammond alloformation consists of a series merged alluvial cones that abruptly flatten out into a broad coastal plain. Faulting has displaced the surface of the Hammond alloformation, creating numerous fault-line scarps.

Within the Watson 7.5-minute quadrangle, the surface of the Hammond alloformation is well preserved and exhibits relict constructional topography although it is entrenched by the modern Amite River and disturbed by gravel mining. In this area, the surface of the Hammond alloformation consists of the distal portion of the alluvial cone of the Amite River. Multiple, well-preserved paleochannels, channel belts, and fluvial ridges can be observed in LiDAR DEMs. The overall slope of the Hammond alloformation is about 0.7 m/km (3.7 ft/mi).

Information concerning the age of the Hammond alloformation in the Watson 7.5-minute quadrangle is lacking. However, optical luminescence dates from the Baton Rouge and Denham Springs areas indicate that the Hammond alloformation is a mixture of sediments that accumulated during Marine Isotope Stages 5 and 3 and postdates Marine Isotope Stage 7 (Shen et al., 2012, 2016).

Peoria Loess (Pleistocene)

Within the western third of the Watson 7.5-minute quadrangle, a blanket of relatively homogeneous, seemingly nonstratified, unconsolidated, well-sorted silt blankets the formations of Pleistocene and Tertiary age. This surficial layer of well-sorted silt, which is called "loess," is recognizable by its unusually massive nature, uniformly tan to brown color, and extraordinary ability to form and maintain vertical slopes or cliffs (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Loess is eolian sediment that accumulated during times of near-maximum to early-waning glaciation. During such periods, seasonally prevailing, strong, north and northwest winds deflated large amounts of silt from recently deposited and unvegetated glacial outwash that accumulated within glacial valley trains. These seasonal winds then transported the material for tens to hundreds of kilometers (tens to hundreds of miles) to the east and south. Eventually, this deflated silt fell out of suspension and incrementally accumulated within adjacent uplands as a drape over either preexisting terraces or dissected, hilly landscape. The greatest amount and relatively coarsest of the silt accumulated closest to the source areas (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Only one loess blanket, Peoria Loess, occurs within the Watson 7.5-minute quadrangle. It thins eastward to the point that it is completely mixed into the underlying sediment as part of the modern soil east of the Amite River. Numerous radiocarbon, thermoluminescence, and optical luminescence dates and other lines of evidence have been used to determine the age of the Peoria Loess. It has been found to be unquestionably of Late Wisconsin age, between 22,000 and 12,500 years BP, and consistent with the age of known meltwater valley trains (Miller et al., 1985; Pye and Johnson, 1988; McCraw and Autin, 1989; and Saucier, 1994).

Holocene alluvium

The Holocene sediments mapped in the Watson 7.5-minute quadrangle consist of undifferentiated deposits of small upland streams; unconsolidated alluvial deposits of minor streams and creeks filling valleys; and the meander belt of the Amite River. The deposits of small upland streams and alluvial deposits of minor streams and creeks have not been studied in detail and are poorly known. The textures of these sediments vary greatly from gravelly sand to either sandy mud or silty mud. Typically, the amount of coarse-grained sediments present directly reflects the texture of the local "bedrock."

In the case of the Amite River valley, the sediments within it reflect its formation by a coarse-grained meandering river. Within it, lateral accretion associated with the secondary development of chutes and cutoffs are the processes that govern sediment deposition. As a result, the floodplain exhibits point bar and scroll bar ridges and active and abandoned thalweg channels and chute channels. The sediments underlying the floodplain consist of two facies, a lower sandy facies and an upper silty facies, associated with these processes and landforms. The lower sandy facies consists of point bar, scroll bar, and channel lag deposits that typically are stratified. The upper silty facies consist of gray and brown silt. The gray silt occurs as lenticular to V-shaped fills of abandoned chute and thalweg channels. The brown silt comprises natural levees and the upper portion of abandoned chute and thalweg channel fills (Autin, 1985, 1989; Mossa and Autin, 1989). These sediments were differentiated by Autin (1989) into three alloformations, known as the Magnolia Bridge, Denham Springs, and Watson alloformations on the basis of unconformable boundaries, landscape morphology, and relative pedogenic development. These units were not mapped in this investigation because of lack of the detailed information needed to differentiate them.

Summary of Results

The surface of the Watson quadrangle comprises the Pleistocene Hammond alloformation, Prairie Allogroup, consisting of sediment deposited by the Amite River and by coastal processes. The Hammond forms part of a coast-parallel belt of terraced Pleistocene strata, and is covered by late Pleistocene Peoria Loess up to slightly greater than 1 m thick. Holocene strata comprise undifferentiated alluvium of the Amite River and its tributaries.

The geologic map of Watson quadrangle provides basic geologic data of potential value to the conduct of aggregate-mining activities in the Amite River flood plain. The area hosts sizable sand and gravel resource potential in Holocene floodplain sediment, Pleistocene strata of the Prairie and Intermediate allogroups, and Pliocene sediment of the Citronelle Formation (Heinrich and McCulloh, 1999). The area has produced significant sand and gravel in the past decade (U.S. Geological Survey, 2011), and production activities have moved progressively northward in recent years. The 1:24,000-scale surface-geologic map of the study area also should serve efforts at protection of the Southern Hills aquifer system in the upper Amite River area.

Acknowledgments

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