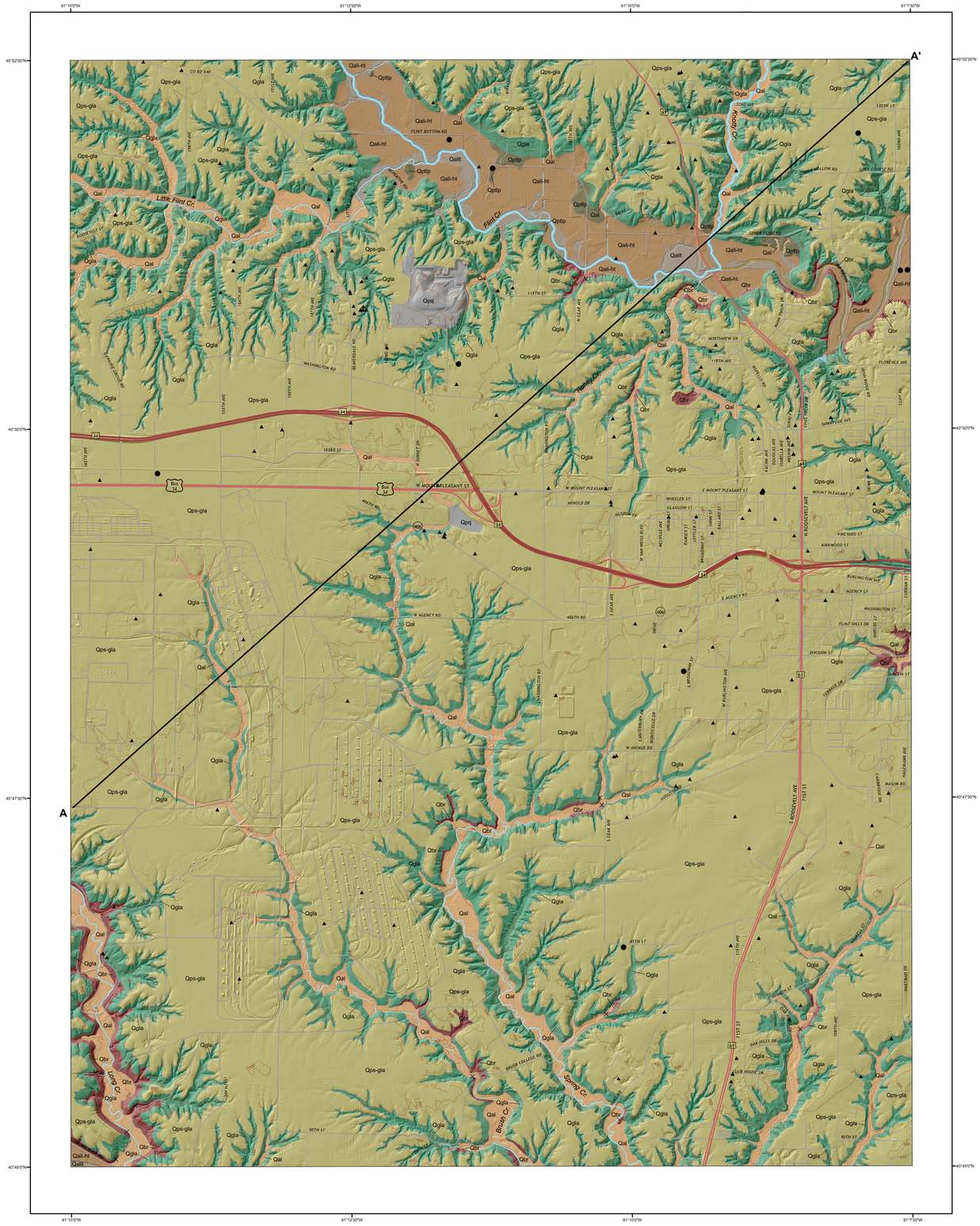
Surficial Geologic Map of the West Burlington (Iowa) 7.5' Quadrangle



1:24,000

0 0.5 1 2 3 4 Miles

0 0.5 1 2 3 4 Kilometers

CONTOUR INTERVAL 50 FEET

MN
GN
0°34′ 6 MILS
1°20′ 21 MILS

UTM GRID AND 2018 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Legend

CENOZOIC

QUATERNARY SYSTEM

HUDSON EPISODE

Qal - Alluvium (DeForest Formation - Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hill slopes and in closed depressions. May overlie Glasford Formation glacial till, Peoria Formation loess or eolian sand, or post-Illinoian sand and gravel. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding.

Qalt - Low Terrace (DeForest Formation - Camp Creek and Roberts Creek members) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, stratified silty clay loam, loam, or clay loam, associated with the modern channel belt of Flint Creek. Overlies post-Illinoian sand and gravel. Occupies the lowest position on the floodplain, ie., modern channel belts. Seasonal high water table and frequent flooding potential.

Qali-ht - Intermediate-High Terrace (DeForest Formation - Roberts Creek and Gunder members) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, silty clay loam to loam alluvium or colluvium. Overlies post-Illinoian sand and gravel along Flint Creek. Occupies terrace and valley margin positions 1 to 2 m (3-7 ft) above the modern floodplain. Seasonal high water table and low to moderate flooding potential.

WISCONSIN EPISODE

Qptlp - Late Phase High Terrace (LPHT) (Peoria Formation - silt and/or sand facies) 2 to 7 m (7-23 ft) of yellowish brown to gray, massive, jointed, calcareous or noncalcareous, silt loam and intercalated fine to medium, well sorted, sand. Grades downward to poorly to modestely well sorted, moderately to well stratified, coarse to fine feldspathic quartz sand, loam, or silt loam alluvium.

Qps-gla - Loess (Peoria Formation - silt facies) Generally 2 to 5 m (7-15 ft) of yellowish to grayish brown, massive, jointed, calcareous or noncalcareous silt loam to silty clay loam. May overlie a grayish brown to olive gray silty clay loam to silty clay (Pisgah Formation eroded Farmdale Geosol) which is less than 1.5 m (5 ft) thick. The Pisgah Formation is in the same stratigraphic position as the Roxanna Silt which is mapped in Illinois. The Farmdale Geosol may be welded to an older Sangamon Geosol developed in loamy glacial till of the Glasford Formation. This mapping unit encompasses upland divides, ridgetops and convex sideslopes. Drainage is variable from well drained to poorly drained.

ILLINOIS EPISODE

Qgla - Till (Glasford Formation) Generally 3 to 10 m (10-33 ft) of very dense, massive, fractured, loamy glacial till of the Illinoian Glasford Formation with or without a thin loess mantle (Peoria Formation- less than 2 m thick) and intervening clayey Farmdale/Sangamon Geosol. Overlies the Yarmouth Paleosol formed in Pre-Illinoian till. This mapping unit encompasses narrowly dissected interfluves and side slopes, and side valley slopes. Drainage is variable from moderately well drained to poorly drained.

PRE-ILLINOIS EPISODE

Qwa3 - Till (Wolf Creek or Alburnett formations) Generally 5 to 20 m (16-66 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations. The Yarmouth Paleosol is formed in this unit, and it is overlain by Illinoian till. Drainage is variable from moderately well drained to poorly drained. This unit is shown only on the cross-section.

Qbr - Loamy Sediments Shallow to Dolomite, Limestone, Shale and Sandstone (DeForest, Peoria, and Glasford formations) 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty sediments that overlie the Mississippian or Devonian bedrock surface. All areas of bedrock outcrop or shallow to bedrock soils are shown in red on the map, regardless of the bedrock mapping unit. Bedrock units are only shown on the cross-section and may be identified on the bedrock map of the West Burlington Quadrangle with the following descriptions:

PALEOZOIC

CARBONIFEROUS SYSTEM

MISSISSIPPIAN SUBSYSTEM

Mpsl – Limestone, Sandstone, and Dolomite (Pella and "St. Louis" formations) Middle-Upper Mississippian, Meramecian-lower Chesterian. This map unit can be up to 12 m (40 ft) thick within the mapping area. It is dominated by limestone and dolomite, partly sandy, with minor shale and chert. Limestones of the Pella Formation are typically sub-lithographic with scattered to abundant fossils, primarily brachiopods, echinoderms, and ostracods. The limestone facies of the "St. Louis" Formation can be fossiliferous with brachiopods, echinoderms, and several varieties of coral while the dolomitic facies typically exhibit fossil molds. Some fossils are silicified. The lower portion of this unit (historically referred to as the Spergen) is commonly gray to dark brown dolomite, locally brecciated and sandy, with rare fossils. This mapping unit is isolated to an upland bedrock high in the western portion of the mapping area. Outcrops of this mapping unit were not found within the mapping area.

Mws – Shale, Dolomite, and Limestone (Warsaw Formation) Upper Osagean. The Warsaw Formation varies in thickness from 3 to 12 m (10 – 40 ft). This unit can generally be divided into two major lithologic groupings, a lower argillaceous dolomite sequence and an upper shale-dominated sequence. The upper shale is typically light to medium gray, silty, and variably dolomitic with minor chert, sand, and sparse quartz geodes. The lower dolomite, sometimes referred to as the "geode beds", is argillaceous to shaly, with scattered to abundant quartz geodes. Minor limestone units occur locally as thin, lenatic beds with crinoidal packstone/grainstone fabrics. Brachiopods, echinoderm debris, and bryozoans are found throughout this mapping unit, although are more common in the carbonate lithologies. This unit exhibits wide variability leaving only the upper shale or lower dolomite in place, suggesting strong erosional unconformities above and below this mapping unit. Outcrops of this unit were not found within the mapping area.

Mkeo – Limestone, Dolomite, Chert, and Shale (Keokuk Formation) Upper Osagean. The Keokuk Formation can be up to 21 m (70 ft) in thickness in the mapping area. This unit is dominated by tan to gray interbedded skeletal limestones displaying packstone/grainstone fabrics. Nodular to bedded chert, in part fossiliferous, is common in the lower half of the sequence. Dolomite, variably argillaceous, and thin shales also occur throughout the unit. The unit displays multiple hardground surfaces and bone beds with scattered to abundant fish debris, the most prominent of these serves as a marker bed at the base of the formation (sometimes referred to as the Burlington-Keokuk or B-K bone bed). Brachiopods, crinoids, bryozoans, solitary corals, and fish bones and teeth occur throughout this unit as both abraded debris and partly articulated specimens. Molds of sponge spicules are noted in the dolomite facies. Traces of glauconite and minor geodes are also found in this formation. A handful of outcrops were found along Long Creek in the southwestern corner as well as on a tributary of Spring Creek in the south-central part of the mapping area.

Mb – Limestone, Dolomite, and Chert (Burlington Formation) Lower Osagean. The Burlington Formation typically ranges between 12 to 18 m (40 – 60 ft) in thickness, reaching a maximum thickness of 23 m (75 ft) within the mapping area. This unit is subdivided into three mbers (in ascending order: the Dolbee Creek, Haight Creek, and Cedar Fork), characterized by distinct lithologic groupings. The Dolbee Creek Member is dominated by white to tan skeletal limestone displaying packstone/grainstone fabrics and nodular to bedded chert. The Haight Creek Member is characterized by dolomite with an intermittent unit of skeletal limestone (sometimes referred to as the "middle grainstone") and thick beds of chert. A glauconite-rich zone marks the lower contact between the Dolbee Creek and can be used as a regional marker bed. Fossil molds are present in the dolomite facies. The Cedar Fork Member is a pure white crinoidal packstone limestone unit which is usually differentiated from the packstones of the overlying Keokuk Formation by its white appearance. Occasional fish debris and glauconite are also observed in this member. Outcrops of this mapping unit can be found throughout the Burlington West Burlington metro area in the northeastern portion of the quadrangle as well as a few locations in the southeastern portion.

Mk – Dolomite, Limestone, and Siltstone (Kinderhookian formations) Lower Mississippian. The Kinderhookian sequence ranges in thickness from 6 to 11 m (20 – 36 ft) reaching a maximum thickness of 20 m (65 ft) within the mapping area. This unit comprises three formations (in ascending order: the McCraney, Prospect Hill, and Wassonville), characterized by distinct lithologic groupings. These formations are separated by minor unconformities noted by the occasional thinning or absence of one or more units observed within the mapping area. The McCraney Formation is composed of alternating beds of sparsely fossiliferous, sub-lithographic limestone and dark brown, unfossiliferous dolomite, generating a unique "zebra striped" appearance in outcrop. A basal oolite is locally present. The Prospect Hill Formation is a light to medium gray, dolomitic siltstone that grades to shale in some locations. This unit is often laminated with vertical and horizontal burrow fabrics and faint cross stratified bedforms. Fossils are rare to absent, although fossil molds are locally abundant. The Wassonville Formation, now including the former Starr's Cave Formation as the basal member, consists of massive dolomite that is variably cherty grading into dolomitic limestone lower in the section. The basal Starr's Cave Member is a fossiliferous limestone with packstone/grainstone fabrics and is commonly oolitic. Crinoids (partly articulated) are the dominant fossil type of the Starr's Cave Member. A diverse assemblage of brachiopods are present with lesser amounts of blastoids, starfish, corals, bryozoans, and trilobites reported. Outcrops of the Kinderhookian were found in the extreme southwest corner of the mapping area along Long Creek as well as in the northeastern corner of the mapping area at Starr's Cave State Preserve and in a bluff above Flint Creek east of Starr's Cave.

DEVONIAN SYSTEM

Der – Siltstone and Shale (English River Formation) Upper Devonian, lower to upper Famennian. The English River Formation ranges in thickness from 4 to 9 m (13 – 30 ft) within the mapping area. This unit is dominated by gray to olive green siltstone with apparent bioturbated fabrics. Bivalves and brachiopods are common, especially in the upper beds, with scattered to abundant fossil molds as well. An outcrop of the English River Formation exists in the base of the exposure at Starr's Cave State Preserve in the northeastern portion of the mapping area.

Dss – Shale (Saverton Shale Formation) Upper Devonian, lower to upper Famennian. The Saverton Shale Formation can be up to 46 m (150 ft) thick within the mapping area. This unit is dominated by green-gray shale, commonly burrowed with sparse to absent macro-fossils. Outcrops of the Saverton Shale Formation were not observed within the mapping area.

Dgc – Shale (Grassy Creek Formation) Upper Devonian, lower to upper Famennian. The Grassy Creek Formation can be up to 50 m (165 ft) thick within the mapping area. This unit is dominated by organic-rich brown shale with minor green-gray shale in the upper part of the unit. Differentiation between the Grassy Creek and the overlying Saverton Shale was primarily based on color and relative abundance of spore scarps identified in well cuttings. Outcrops of the Grassy Creek Formation were not observed within the mapping area.

OTHER FEATURES

Water features - Rivers, lakes and small ponds. Extent mapped as shown in the county soil survey and as identified on aerial imagery.

Incorporated city boundary

New drill holes for this map project

Bedrock Outcrops

IGS GEOSAM data points - records available at www.iowageologicalsurvey.org

Roads

W1429 **Wells used for geologic cross-section**

Qpq **Qpq - Pits and Quarries** - Sand and gravel pits, borrow pits, and rock quarries. Extent mapped as shown on the county soil survey and as identified on aerial imagery.

Correlation of Map Units

	Shallow Bedrock	Flint Creek	Upland	Episode	Series	Stage
Alluvium	Qbr	Qaltt	Qal	Hudson	Holocene	Quaternary
		Qali-ht				
Loess		Qptlp	Qps-gla	Wisconsin	Pleistocene	
Glacial Till		Qgla		Illinois		
		Qwa3*		Pre-Illinois		
Bedrock	Mpsl*			Mississippian		
	Mws*					
	Mkeo*					
	Mb*					
	Mk*					
	Der*			Devonian		
	Dss*					
	Dgc*					

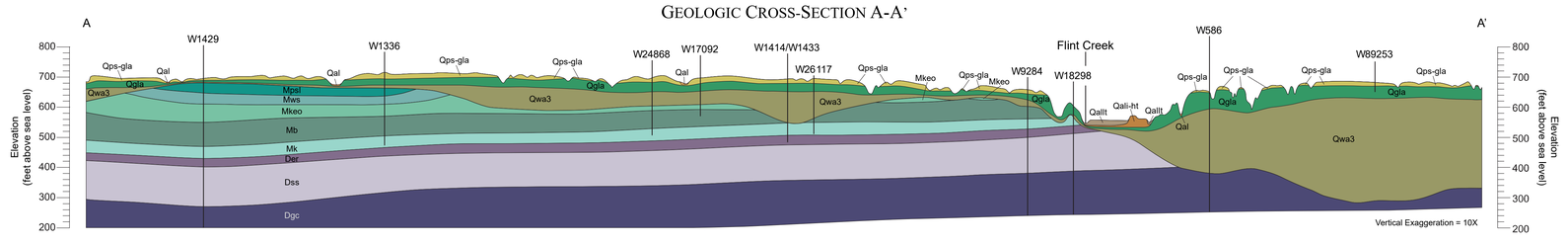
*Units only shown on the Cross-Section

Adjacent 7.5' Quadrangles

PLEASANT GROVE, IOWA	SPERRY, IOWA	KINGSTON, IOWA-ILL.
DANVILLE, IOWA	WEST BURLINGTON, IOWA	BURLINGTON, IOWA-ILL.
FORT MADISON, IOWA-ILL.	DALLAS CITY, IOWA-ILL.	LOMAX, ILL.-IOWA

Location Map

Geologic Cross-Section A-A'



Surficial Geologic Map of the West Burlington 7.5' Quadrangle, Des Moines County, Iowa

Iowa Geological Survey
Open File Map OFM-18-6
June 2018

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Supported in part by the U.S. Geological Survey
Cooperative Agreement Number G17AC00258
National Cooperative Geologic Mapping Program (STATEMAP)
Completed under contract with the Iowa Department of Natural Resources
This work partially funded by a National Science Foundation Award:
Improving Undergraduate STEM Education: GP-IMPACT-1600429.

Acknowledgments

Special thanks to the landowners who allowed access to their properties for drilling: Doug Beckman, Kirk Danforth (Rec Plex Manager, City of Burlington), Chris Lee (Executive Director) and Jeff Brezer of the Des Moines County Conservation Board, Loretta Oetken, Eric Tysland (Development & Parks Director, City of Burlington), and Daxid Wagner. Drilling was provided by Matthew Streeter of the Iowa Geological Survey (IGS). Jason Vogelgesang and Zachary Demanett of the IGS and University of Iowa (UI) students Brittany Stoffus and Clint Henning provided field assistance. UI students Travis Maher and Carsyn Ames prepared well cutting samples for stratigraphic logging. New subsurface geologic data was generated by Tanner Hartsock, Nick Johnson, and Diar Ibrahim, UI Department of Earth and Environmental Sciences students, by producing descriptive logs of water well drilling samples. UI students Tanner Hartsock, Nick Leffler, and Nick Johnson helped with well locations and data management. Thanks also to Rick Langel (IGS) for managing the Iowa geologic sampling database (GeoSam). Special thanks to Kathy Wolda of the Natural Resources Conservation Service and Art Bettis, UI Department of Earth and Environmental Sciences, for assistance with core description and for numerous valuable discussions regarding the geology of southeast Iowa. Casey Kohrt and Chris Kahle of the Iowa Department of Natural Resources provided GIS technical help. Administrative support was provided by Megan Delaney, Melissa Eckrich, Teresa Gaffey, Angi Roemerman, Carmen Langel, and Rosemary Tiwari

Introduction to the Surficial Geologic Map of the West Burlington Quadrangle, Des Moines County, Iowa

The West Burlington Quadrangle is located in southeastern Iowa on the Southern Iowa Drift Plain landform region (Prior and Kohrt, 2006). The map area is dominated by loess mantled till plains in the uplands, and fine to coarse grained alluvial deposits within Flint Creek and its tributaries. Stratigraphically, this area contains Illinoian age glacial deposits, which are only present in a small area of southeastern Iowa. The terminal moraine for the Illinoian glacial advance is 10 to 11 miles west of the mapping area. The thickness of Quaternary materials varies widely across the quadrangle ranging from 5 to 20 m (16-66 ft), reaching a maximum thickness of 125 m (410 ft) in the northeastern part of the mapping area. Bedrock outcrops are common in Long Creek and are also located along portions of Brush, Spring, Honey, and Flint creeks.

Mapping the Lowell and Danville quadrangles (Tassier-Surine et al., 2017a,b) provided the first study of the regional Quaternary stratigraphy of southeast Iowa in almost 40 years when Hallberg (1980a,b) established the stratigraphy for the Illinoian and Pre-Illinoian glacial advances in eastern and southeastern Iowa. The majority of the drill cores and outcrops for those studies were north of the West Burlington Quadrangle. Additional data available since that time (LIDAR, DEMs, and digital soil surveys), have allowed for the refinement of the Illinoian boundary and greater detail in mapping the valleys. The only other surficial map of the area consists of the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). Several Iowa Geological Survey (IGS) field trip guidebooks outline the Pleistocene, Devonian, and Mississippian stratigraphy (Witzke et al., 2002; Witzke and Tassier-Surine, 2001) in this area.

The soil survey of Des Moines County (Brown, M.D., 1983) provided information regarding shallow rock areas, helped to guide valley mapping units, and defined slope areas where glacial till is exposed. Subsurface information was mostly derived from the analysis of water well cutting samples reposited by the IGS. Lithologic and stratigraphic information from these samples are stored in the online GeoSam database of the IGS. Additionally, IGS drilled nine cores in the quadrangle to characterize the Quaternary sediments and establish unit thickness.

The glacial history of Iowa began more than two million years ago, as at least seven episodes of Pre-Illinoian glaciation occurred between approximately 2.6 and 0.5 million years ago (Boellstorff, 1978a,b; Hallberg, 1980a). In east-central Iowa, Hallberg formally classified the units into two formations on the basis of differences in clay mineralogy: the Alburnett Formation (several undifferentiated members) and the younger Wolf Creek Formation (including the Winthrop, Aurora and Hickory Hills members). Both formations are composed predominantly of till deposits, but other materials are present. Paleosols are formed in the upper part of these till units.

A limited area of southeastern Iowa was glaciated during the Illinois Episode, around 190,000-130,000 years ago (Curry et al., 2011). The West Burlington Quadrangle was glaciated during this time. The Illinoian till was deposited by the advancing Lake Michigan Lobe which moved across western Illinois into Iowa from the northeast (Leverett, 1899; Wickham, 1980). The Lake Michigan Lobe incorporated Paleozoic bedrock materials from the Lake Michigan Basin which are distinguished by both the clay mineralogy of the matrix as well as the pebbles and clasts (Lineback, 1980; Wickham, 1980). Hallberg (1980b) defined the formal stratigraphic nomenclature in Iowa. The only Illinoian Episode till present in Iowa is the Glasford Formation Kellerville Till Member (Willman and Frye, 1970). Following the Illinoian glaciation, this area underwent landscape development and erosion until the Wisconsin Episode loess began to be deposited. The Illinoian till is only exposed in drainages and relatively steep sideslopes.

In eastern Iowa, the highly eroded and dissected Illinoian and Pre-Illinoian upland and older terraces are mantled by two Wisconsin loesses. The older Pisgah Formation is thin and includes loess and related slope sediments that have been altered by colluvial hillslope processes. The unit is characterized by the presence of a weakly developed soil recognized as the Farmdale Geosol. It is not uncommon to see the Farmdale developed throughout the Pisgah and into the underlying older Sangamon Paleosol. The Pisgah loess was most likely deposited on the eastern Iowa landscape from 30,000 to 24,000 years ago (Bettis, 19989) and is typically buried by Peoria Formation loess. The Peoria Formation loess accumulated on stable landsurfaces in eastern Iowa from 25,000 to 21,000 years ago. Peoria Formation eolian materials mantle the upland till units and are present on terraces in Flint Creek. On the uplands, the Peoria Formation is a uniform silt loam; in the valleys the silt commonly grades downward to fine sand.

Coarse sand deposits are found below the Holocene alluvial units in Flint Creek. The age of these deposits is unknown, but they are younger than the Illinoian deposits. Throughout most of Flint Creek, these alluvial deposits range in thickness from two to five meters (6-16 ft). However, downstream of Starr's Cave, alternating sequences of fine and coarse grained alluvium are present for a combined depth of greater than 15 meters (50 ft). This sequence is likely related to backwater deposits of the Mississippi River. Hudson age deposits are associated with fine-grained alluvial, organic, and colluvial sediments and include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, and Gunder members. These deposits are present in valleys and upland drainages throughout the map area.

Surficial deposits in the map area are composed of six formations (youngest to oldest): Hudson DeForest; Wisconsin Peoria and Pisgah; Illioian Glasford; and Pre-Illinoian Wolf Creek and Alburnett. Eight bedrock mapping units (the Mississippian Pella and "St. Louis", Warsaw, Keokuk, Burlington, and Kinderhookian formations and the Devonian English River, Saverton Shale, and Grassy Creek formations) are exposed at the bedrock surface in the West Burlington Quadrangle. The Mississippian Keokuk, Burlington, and Kinderhookian formation comprise most of the bedrock outcrop in the map area. See Clark and others (2018) for a detailed bedrock geologic map of the West Burlington Quadrangle.

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Base map is a 600 dpi Digital Raster Graphic (IGS GIS file IA_West_Burlington_USGS_topo.tif) which was scanned and modified from the West Burlington 7.5' Topographic Quadrangle map, published by The US Geological Survey in 2015 Land elevation contours (10' interval).

Iowa Geological Survey digital cartographic file West_Burlington_SurficialGeology.mxd, version 6/30/18 (ArcGIS 10.5) Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15N, datum NAD83.

The map and cross-section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.

Research supported by the U. S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G17AC00258. 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.