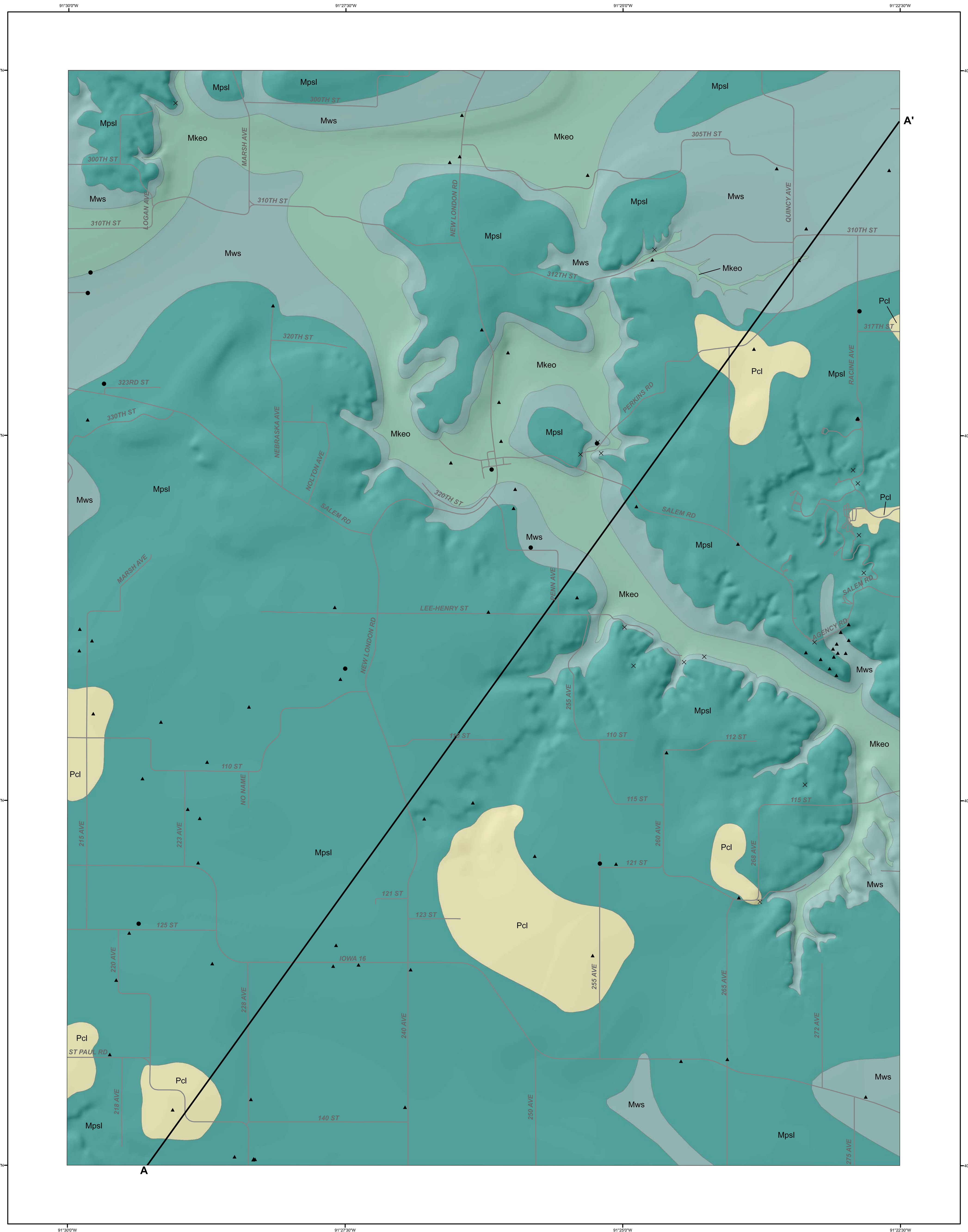
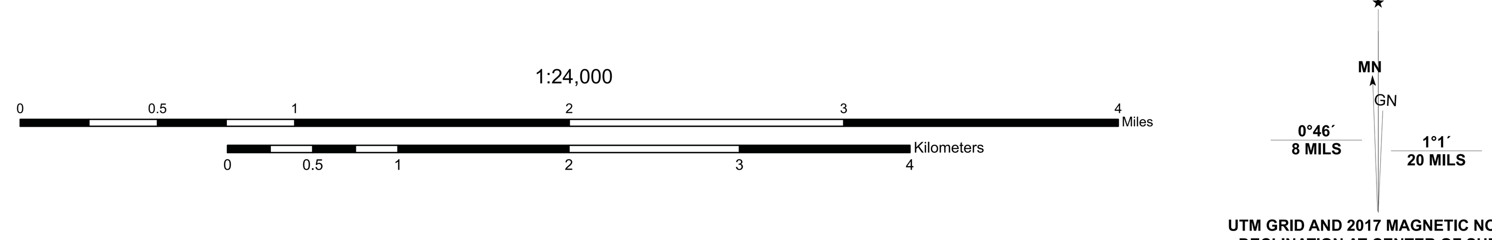
Bedrock Geologic Map of the Lowell (Iowa) 7.5' Quadrangle

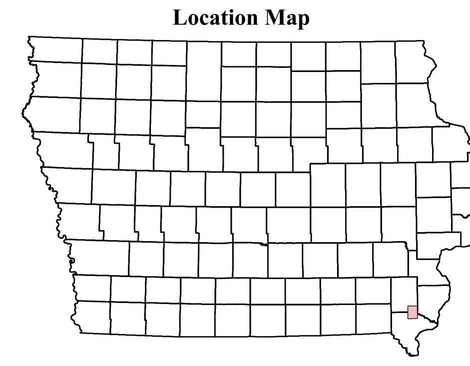




Adjacent 7.5' Quadrangles

MT. PLEASANT IOWA	NEW LONDON IOWA	PLEASANT GROVE IOWA
SALEM IOWA	LOWELL IOWA	DANVILLE IOWA
DONNELLSON IOWA	WEST POINT IOWA	FORT MADISON IOWA-ILL

Location Map



LEGEND

CENOZOIC

QUATERNARY SYSTEM

Qu - Undifferentiated Unconsolidated Sediments - Consists of loamy soils developed in loess, glacial till, and colluvium of variable thickness, and alluvial clay, silt, sand, and gravel. The total thickness of the Quaternary deposits varies between 0 and 18 m (0 – 60 ft), but can be as much as 64 m (210 ft) thick in the northern part of the mapping area. This unit is shown only on the cross-section, not on the map.

PALEOZOIC

CARBONIFEROUS SYSTEM

PENNSYLVANIAN SUBSYSTEM

Pcl - Sandstone and Shale (lower Cherokee Group) Lower-Middle Pennsylvanian. Pennsylvanian units occur as erosional outliers reaching a thickness of up to 5 m (15 ft) within the mapping area. This unit consists of shale/mudstone, light to medium gray, part silty to sandy and fine to medium quartz sandstone, rarely conglomeratic. Some shales are carbonaceous to phosphatic with minor coal and rare limestone lithologies present. Only one outcrop of this map unit was identified in the mapping area.

MISSISSIPPIAN SUBSYSTEM

Mpsl – Limestone, Sandstone, and Dolomite (Pella or "St. Louis" formations) Middle-Upper Mississippian, Meramecian-lower Chesterian. This map unit ranges between 12 and 24 m (40 – 80 ft) thick in the mapping area. It is dominated by limestone, sandstone, dolomitic limestone, and dolomite with minor shale. Limestones of the Pella Formation are typically sub-lithographic with scattered to abundant fossils, primarily brachiopods, echinoderms, and ostracods. The "St. Louis" Formation is dominated by limestone, sandy limestone, sandstone, and dolomite, variably cherty. The limestone facies of this unit can be fossiliferous with brachiopods, echinoderms, and several varieties of coral while the dolomitic facies typically exhibit fossil molds. Some fossils are silicified. Sandstones of the "St. Louis" Formations are typically very fine to medium quartz sandstones that are poorly to moderately cemented with calcite or quartz. The lower portion of the "St. Louis" Formation is commonly gray to dark brown dolomite, locally brecciated and sandy, with rare fossils. This mapping unit dominates the bedrock surface in the mapping area and is overlain by Quaternary sediments or Pennsylvanian outliers. Outcrops of this mapping unit are found in the Geode State Park area, upland ridges of the Skunk River valley, and in quarries.

Mws – Shale, Dolomite, and Limestone (Warsaw Formation) Upper Osagean. The Warsaw Formation varies in thickness reaching a maximum thickness of approximately 17 m (55 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, lensatic beds with crinoidal packstone/grainstone fabrics. Brachiopods, echinoderm debris, and bryozoans are found throughout this mapping unit, although 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 are rare due to the selective weathering of the shale creating recessive exposures beneath ledges of the overlying "St. Louis" formations although several outcrops were observed along the Skunk River and Mud Creek.

Mkeo – Limestone, Dolomite, Chert, and Shale (Keokuk Formation) Upper Osagean. The Keokuk Formation typically ranges from 12 to 23 m (40 – 75 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 locally abundant geodes were also observed within the mapping area. One possible outcrop of this mapping unit was found near the Mud Creek County Recreation Area in the northern part of the mapping area.

Mb – Limestone, Dolomite, and Chert (Burlington Formation) Lower Osagean. The Burlington Formation can be up to 26 m (85 ft) thick in the mapping area. This unit is subdivided into three members (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 also 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 the Burlington Formation are typically found along the Skunk River and its tributaries and in select quarries along the southeastern boundary of the mapping area. This unit is shown only on the cross-section, not on the map.

Mk – Dolomite, Limestone, and Siltstone (Kinderhookian formations) Lower Mississippian. The Kinderhookian sequence ranges in thickness from 5 to 15 m (20 – 50 ft) with a maximum thickness of 23 m (75 ft) in the mapping area. This unit comprises three formations (in ascending order: the McCraney, Prospect Hill, and Wassonville), characterized by distinct lithologic groupings. 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 are found just outside the southeastern corner of the mapping area and in the sump pit of a quarry located along the southeastern boundary of the mapping area. This unit is shown only on the cross-section, not on the map.

DEVONIAN SYSTEM

Der – Siltstone and Shale (English River Formation) Upper Devonian, lower to upper Famennian. The English River Formation is up to 6 m (20 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. This unit appears only in the cross-section and not on the map.

Dss – Shale (Saverton Shale Formation) Upper Devonian, lower to upper Famennian. The Saverton Shale Formation can be up to 46 m (150 ft) within the mapping area. This unit is dominated by green-gray shale, commonly burrowed with sparse to absent macro-fossils. This unit appears only in the cross-section and not on the map.

OTHER FEATURES

- ● **New drill holes for this map project**
- × **Bedrock outcrops**
- ▲ **IGS GEOSAM data points** – records available at www.iowageolocialsurvey.org
- ⚒ **Quarries**
- **Roads**
- W29402 **Wells used for geologic cross-section**
- **Bedrock Hillshade -** shades of gray show the bedrock surface as it would be illuminated by an artificial light source from the NW direction

STRATIGRAPHIC COLUMN

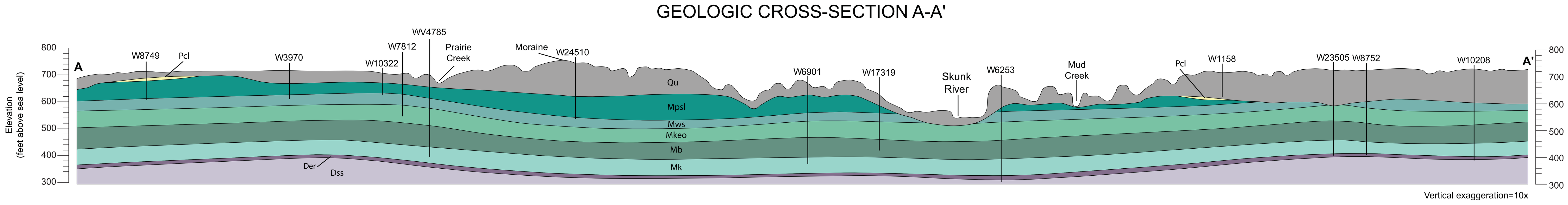
System[1]	Subsystem[1]	Series[1]	Stage[2]	Lithostratigraphic Unit	Map Symbol	Lithology	Thickness (in feet)
Carboniferous	Pennsylvanian	Lower	Morrowan?	lower Cherokee Group	Pcl		10-45
Carboniferous	Mississippian	Upper / Middle	Chesterian / Meramecian	Pella or "St. Louis" fms.	Mpsl		>80
Carboniferous	Mississippian	Middle	Osagean	Warsaw Fm.	Mws		15-50
Carboniferous	Mississippian	Middle / Lower	Osagean	Keokuk Fm.	Mkeo		30-75
Carboniferous	Mississippian	Lower	Osagean	Burlington Fm.	Mb		55-80
Carboniferous	Mississippian	Lower		Kinderhookian	Mk		30-75
Devonian		Upper	Famennian	English River Fm.	Der		<20
Devonian		Upper	Famennian	Saverton Shale Fm.	Dss		>100

[1]Global stratigraphic units
[2]Regional stratigraphic units

Lithologies
- Dolomite
- Dolomitic shale
- Fossiliferous Packstone
- Limestone
- Lithographic Limestone
- Sandstone
- Sandy Limestone
- Shale
- Siltstone

Symbols
- ⊗ Geodes
- ▵ Chert
- ⊙ Oolitic
- — Argillaceous zone
- Breccia
- Unconformity

GEOLOGIC CROSS-SECTION A-A'



BEDROCK GEOLOGIC MAP OF
THE LOWELL 7.5' QUADRANGLE,
DES MOINES, HENRY, AND LEE COUNTIES, IOWA

Iowa Geological Survey
Open File Map OFM-17-5
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Introduction to the Bedrock Geologic Map of the Lowell 7.5' Quadrangle, Des Moines, Henry, and Lee Counties, Iowa

The Lowell Quadrangle lies within the Southern Iowa Drift Plain landform region (Prior, 1991). This area hosts glacial deposits over 500,000 years old containing a thick till package mantled by loess draped over upland hill slopes. Numerous rills, creeks, and rivers branch out across the landscape shaping the old glacial deposits into steeply rolling hills and valleys.

The thickness of Quaternary materials overlying the bedrock surface varies widely across the quadrangle ranging from 0 to 18 m (0 – 60 ft), reaching a maximum thickness of 64 m (210 ft) in the northern part of the mapping area. Shallow bedrock information from the soil surveys in Des Moines, Henry, and Lee counties (Brown, 1983; Seaholm, 1985; and Lockridge, 1979) was used for identifying potential bedrock outcrop locations during field mapping activities. Bedrock outcrops were found mostly along the Skunk River and its tributary creeks like Mud Creek and Cedar Creek, primarily in the eastern half of the quadrangle. Outcrops exposed are comprised of Pella and "St. Louis", Warsaw, and Keokuk formation rocks with one outcrop of Pennsylvanian bedrock. Subsurface information was mostly derived from the analysis of water well cutting samples reposited at the Iowa Geological Survey (IGS). Lithologic and stratigraphic information from these samples are stored in the online GeoSam database of the IGS. Geologic information from three quarries, 17 outcrops, and more than 200 private and public wells within the Lowell Quadrangle and surrounding area were used for bedrock geologic mapping purposes.

The Mississippian System (now Subsystem) was historically proposed for the succession of strata exposed in the Mississippi River Valley between Burlington, Iowa and southern Illinois. Therefore, the bedrock exposures in southeastern Iowa take on a special significance as they comprise part of the historic "body stratotype" on which the concept of the Mississippian System was defined and based (Witzke et al., 2002). The Mississippian had been primarily a North American chronostratigraphic label roughly synonymous with the Lower Carboniferous of the Old World. After approval by the Subcommission on Carboniferous Stratigraphy in 1999 and ratification by the International Union of Geological Sciences and the International Commission on Stratigraphy in 2000, the Carboniferous System was officially subdivided into lower and upper subsystems, the Mississippian and Pennsylvanian, respectively. As such, the Mississippian now has meaning and application as a major subdivision of geologic time not only in North America, but as a globally defined subsystem. The bedrock strata seen in the Lowell Quadrangle and the surrounding area provide a significant historic reference for the Mississippian as a whole.

The conundrum that is the Mississippian in Iowa has been the subject of curiosity for many previous workers. Owen (1852) and Hall (1857) were the first to recognize that the abundant bedrock exposures in southeastern Iowa likely correlated with those observed farther down the Mississippi River Valley. Decades later, Van Tuyl (1923) took on the ambitious task of correlating all of the Mississippian units across Iowa. Many of their lithologic interpretations were valuable, however, the correlations were, and continue to be, subject to revision as later workers attempted to piece the Mississippian into the global stratigraphic framework. Harris and Parker (1964) provided inspirational insights into the structural context of southeastern Iowa by identifying a series of northwest-southeast trending anticlines that were later found to be superimposed on the larger northeast-southwest trending structural feature known as the Mississippi Arch (Witzke et al., 1990, p. 5). Many questions remain regarding the stratigraphic correlations within the Mississippian such as whether the "St. Louis" Formation in Iowa truly belongs in the St. Louis Formation or should some of the upper members be reassigned to the St. Genevieve Formation; whether the Prospect Hill Formation is an offshoot of the Hannibal Formation in Missouri and Illinois; and whether the McCraney Formation is correlative to the McCraney in Illinois or if it should become a new stratigraphic interval (as proposed by Witzke et al., 2002). Although the Mississippian bedrock in southeastern Iowa is no longer a widely used aquifer due to low yields and locally poor water quality, many of the bedrock units are highly desirable sources of aggregate, thus necessitating the continued effort to gain a better understanding of the local and regional stratigraphic characteristics and relationships of the Mississippian System in southeastern Iowa.

The mapping area is dominated by bedrock of the Mississippian System that was deposited in a variety of marine environments from the late Kinderhookian to early Chesterian, approximately 355 – 330 million years ago (Ogg et al., 2008). Kinderhookian strata represent a sequence of interbedded carbonates and siltstones that unconformably underlie the Burlington Formation (early Osagean) and are not exposed at the bedrock surface within the mapping area. The Burlington, Keokuk, and Warsaw formations (collectively the Augusta Group of Witzke et al., 2010) represent a relatively conformable package of marine rocks deposited during the Osagean transgressive-regressive (T-R) cycle. Interpreted as part of the central middle shelf of the Osagean sea that transgressed toward the northwest and the Transcontinental Arch, the Burlington Formation rocks were deposited across a vast subtidal epicontinental shelf that stretched from Illinois and Iowa into central Kansas and Oklahoma (Lane, 1978; Witzke et al., 1990, p. 55). The Keokuk and Warsaw formations represent the regressive phase of the Osagean T-R cycle punctuated by a stark unconformity below the overlying Pella and "St. Louis" formations, regionally displaying up to 40 m (130 ft) of erosional relief (Witzke et al., 2002). The Pella and "St. Louis" formations are mapped as one unit due to their stratigraphic complexity and questionable correlation to the type sections in Missouri and Illinois (Witzke et al., 1990, p. 23). The Pella and "St. Louis" formations were deposited in a near-shore environment as evidenced by mudflat facies rocks, evaporites and associated collapse breccias, and increased terrigenous sandstone deposits, with periods of brackish and/or lacustrine deposition interpreted from coal deposits and root casts (Witzke et al., 2002). Pennsylvanian bedrock units of the lower Cherokee Group occur as erosional outliers and are not well exposed in the mapping area. For a more detailed description of the lithologic units and further discussion of mapping methodologies, please refer to the accompanying Summary Report.

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Base map from Iowa DOT Road map Layers 2006. Bedrock topography raster created internally for this map project.

Iowa Geological Survey digital cartographic file Lowell_BedrockGeology.mxd, version 6/30/17 (ArcGIS 10.3)
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.

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