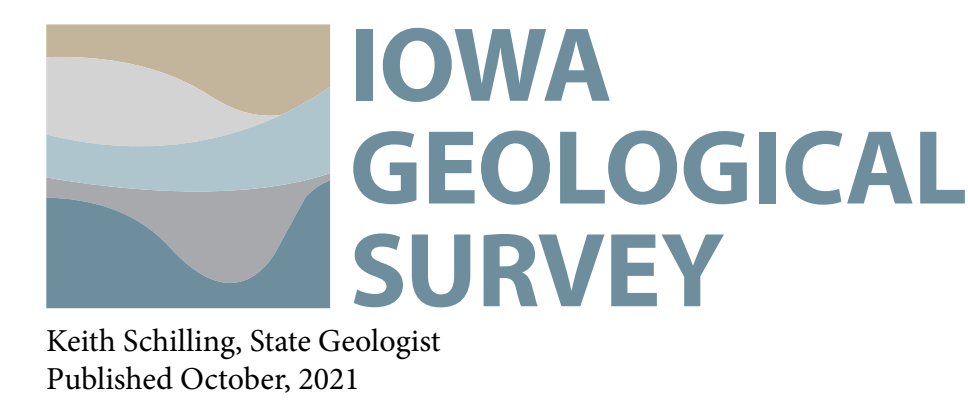


SURFICIAL GEOLOGIC MAP OF BENTON COUNTY, IOWA

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Open File Map: OFM-21-1



INTRODUCTION

Benton County is located in east central Iowa and is part of both the Iowan 'Erosion' Surface and the Southern Iowa Drift Plain landform regions. Benton County is on the Iowan 'Erosion' Surface largely within the Cedar River watershed and is dominated by dissected till plains with unnamed Wisconsinan reworked periglacial sediments and elongated loess-covered uplands called paha. The Southern Iowa Drift Plain is mostly in the Iowa River watershed and is characterized by thick loess generally found over a clayey Farmdale/Sangamon Geosol formed in till. Stratigraphically, Benton County contains Wisconsinan collian and/or colluvial sediments over Pre-Illinoian age glacial till which overlie Paleozoic carbonates and shales. The thickness of Quaternary deposits in Benton County ranges from 0 m to over 120 m (0-400 ft). Depth to bedrock in the northern half of the county is on average around 10 to 20 m (33-66 ft), while it is generally over 60 m (200 ft) in the southern part of the county.

New data collected for this mapping project consisted of 84 drill cores, which included 11 drilling transects, and this data was further supplemented with 44 hand auger or hand probe locations. New subsurface information was derived from the analysis of over 1,250 water well records. Additional information regarding the surficial mapping units and stratigraphy may be found in the accompanying Summary Map Report.

LEGEND

CENOZOIC

QUATERNARY SYSTEM

HUDSON EPISODE

- Qo** - **Depressions** (DeForest Formation- Woden Member) Generally 2.5 to 6 m (8-20 ft) of black to very dark gray, calcareous, muck, peat and silty clay loam colluvium and organic sediments in drained and undrained closed and semi-closed depressions. Overlies gray, calcareous, loam diamictum (Wolf Creek or Alburnett formations) or Noah Creek Formation sand and gravel. Associated with low relief features that occupy depressions and low sags on the landscape. Supports wetland vegetation and can be permanently covered by water. High water table.
- 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 Wolf Creek or Alburnett glacial till, Peoria Formation loess or collian sand, or Wisconsinan sand and gravel of the Noah Creek Formation. Associated with low-relief modern floodplain, closed depressions, modern drainage ways or topsoil positions on the landscape. Seasonal high water table and potential for frequent flooding.
- Qalb** - **Alluvium Shallow to Bedrock** (DeForest Formation - Undifferentiated) - Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous or calcareous, massive to stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium on hilltops, on hill slopes, and in closed depressions. May overlie the Noah Creek, Wolf Creek/Alburnett formations, or fractured Devonian bedrock. Bedrock surface is within 5 m (16 ft) of the land surface. Associated with low-relief modern floodplains, modern drainage ways, or topsoil positions on the landscape. Seasonal high water table and potential for frequent flooding.
- Qallt** - **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 the Cedar and Iowa rivers and their tributaries. Overlies Wisconsinan sand and gravel of the Noah Creek Formation. Occupies the lowest position on the floodplains, i.e., the 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 Wisconsinan sand and gravel of the Noah Creek Formation or Devonian aged bedrock. Occupies terrace and valley margin positions 1 to 2 m (3-7 ft) above the modern floodplain of the Cedar and Iowa rivers and their tributaries. Seasonal high water table and low to moderate flooding potential.
- Qaf** - **Alluvial fan** (Corrington Member) Variable thickness of 2 to 5 m (7-16 ft) of dark brown to yellowish brown, noncalcareous, silt loam to loam with interbedded lenses of fine sand and silts. A pebble lag is commonly found at or near the fan surface. Overlies thick sand and gravel of the Noah Creek of the Cedar and Iowa rivers and their tributaries as steep angled fans at the base of low order drainages and colluvial slopes.

WISCONSIN EPISODE

- Qps1** - **Loess and Interbedded Eolian Sand** (Peoria Formation - silt and/or sand facies) Generally 2 to 5 m (7-16 ft) of yellowish brown to gray, massive, fractured, noncalcareous grading downward to calcareous, silt loam and interbedded fine to medium, well-sorted sand. Sand is most abundant in the lower part of the eolian package. Overlies massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations with or without the intervening clayey Farmdale/Sangamon Geosol.
- Qps1b** - **Thick Loess and Interbedded Eolian Sand** (Peoria Formation - silt and/or sand facies) Generally 5 to 15 m (16-49 ft) of yellowish brown to gray, massive, noncalcareous grading downward to calcareous silt loam and interbedded fine to medium, well sorted, sand. Overlies massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations with or without intervening clayey Farmdale-Sangamon Geosol.
- Qps2** - **Eolian Sand and Interbedded Silt** (Peoria Formation - sand facies) Generally 5 to 15 m (16-49 ft) of yellowish brown to gray, moderately well-stratified noncalcareous or calcareous, fine to medium, well-sorted, eolian sand. May contain interbeds of yellowish brown to gray, massive, silt loam loess. This unit may form large dunes in river valleys or the upland landscape. Overlies eroded, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations or fractured Devonian-age carbonate bedrock.
- Qps6** - **Eolian Dunes and Sand Sheets Shallow to Glacial Till** (Peoria Formation - sand facies) Generally 2 to 4 m (7-14 ft) of yellowish brown, massive to well-stratified, noncalcareous, fine to medium, well-sorted feldspathic quartz sand. Overlies pebbly loam erosion surface sediment which, in turn, overlies eroded massive, jointed, firm, loamy glacial till of the Wolf Creek or Alburnett formations.
- Qnw2** - **Sand and Gravel** (Noah Creek Formation) Generally 2 to 10 m (6-33 ft) of yellowish brown to gray, poorly to well-sorted, massive to well stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel with few intervening layers of silty clay. A thin mantle of loess, reworked loess or fine-grained alluvium may be present. This unit includes silty colluvial deposits derived from the adjacent map units. This unit also encompasses "pre-Gunder Member" deposits that accumulated in low-relief stream valleys. Seasonal high water table and some potential for flooding.
- Qnw3** - **Sand and Gravel Shallow to Bedrock** (Noah Creek Formation) Variable thickness of 1 to 6 m (3-20 ft) of yellowish brown to gray, poorly to well-sorted, massive to well-stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. May be overlain by up to 3 m (10 ft) of silty alluvial material. In places, this unit can be mantled with fine to medium, well-sorted feldspathic quartz sand derived from wind reworking of the alluvium. Fractured carbonate bedrock is less than 6 m (20 ft) below the land surface. The unit encompasses deposits that accumulated in river and stream valleys during the late Wisconsin.
- Qnw** - **Sand and Gravel** (Noah Creek Formation) Variable thickness of 3 m (10 ft) to more than 30 m (100 ft) of yellowish brown to gray, poorly to well-sorted, massive to well-stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. In places, mantled with 1 to 3 m (3-10 ft) of fine to medium, well-sorted sand derived from wind reworking of the alluvium. This unit encompasses deposits that accumulated in the Cedar and Iowa river valleys during the Wisconsin Episode.
- Qnw T2** - **Sand and Gravel** (Noah Creek Formation) Up to 28 m (93 ft) of yellowish brown to gray, poorly to well-sorted, massive to well-stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. In the map area, this unit overlies Devonian carbonate bedrock or the Wolf Creek or Alburnett formations. This unit encompasses outwash deposits that accumulated in valleys during the Wisconsin Episode in the Cedar River valley. This unit represents the younger, lower terrace and generally sits 7 m (23 ft) above the modern channel.
- Qnw T1** - **Sand and Gravel** (Noah Creek Formation) Up to 30 m (100 ft) of yellowish brown to gray, poorly to well-sorted, massive to well-stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel. In the map area, this unit overlies Devonian carbonate bedrock or the Wolf Creek or Alburnett formations. This unit encompasses outwash deposits that accumulated in valleys during the Wisconsin Episode in the Cedar River valley. This unit represents the older, higher terrace and generally sits 3 m (10 ft) above the lower terrace and 10 m (33 ft) above the modern channel.
- Qwa2** - **Loamy and Sandy Sediment Shallow to Glacial Till** (Unnamed erosion surface sediment) Generally 2 to 8 m (6-26 ft) of yellowish brown to gray, massive to weakly-stratified, well to poorly-sorted loamy, sandy and silty Iowan Erosion Surface sediment. Map unit includes some areas mantled with less than 2 m (7 ft) of Peoria Formation materials (loess and collian sand). Overlies massive, fractured, firm, glacial till of the Wolf Creek and Alburnett formations. Seasonal high water table may occur in this map unit.

PRE-ILLINOIS EPISODE

- Qwa3** - **Glacial Till** (Wolf Creek or Alburnett formations) - Generally 3 to 15 m (10-50 ft) but can be more than 73 m thick (240 ft) within the bedrock valley in the southeast part of the mapping area. This mapping unit consists of very dense, massive, fractured, clay loam glacial till of the Wolf Creek or Alburnett formations. This mapping unit can be overlain by unnamed erosion surface sediments, colluvium, outwash, loess, eolian sand, or alluvium. This unit may include >10 m (33 ft) Pre-Illinoian sand and gravel bodies at depth.

OTHER MAPPING UNITS

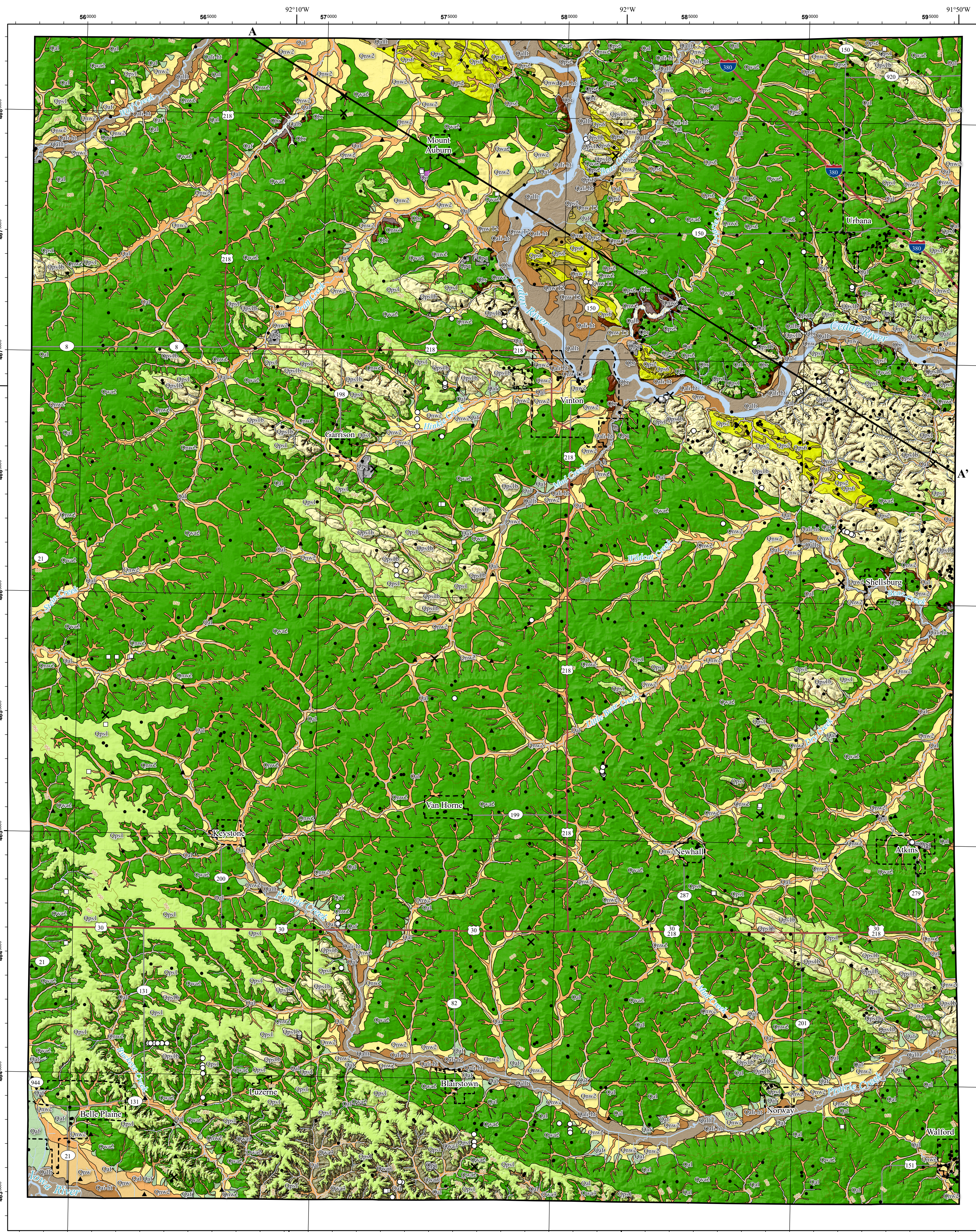
- Qbr** - **Loamy Sediments Shallow to Dolostone, Limestone, and Shale** (DeForest, Peoria, Noah Creek, Wolf Creek, and Alburnett formations) 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly-stratified, well to poorly-sorted loamy, sandy and silty sediments that overlie the Devonian bedrock surface. All areas of bedrock outcrop or shallow to bedrock soils are shown in red on the map. For detailed description of bedrock units see the bedrock maps of the Vinton and Center Point NW 7.5' quadrangles (Lui et al. 2019 a,b).
- Qpsq** - **Pits and Quarries** - Sand and gravel pits and rock quarries. Extent mapped as shown on the county soil survey and as identified on aerial imagery.

CORRELATION CHART

General Lithology	River Valley			Upland		Shallow Rock		Episode	Series	System
	Qal	Qallt	Qali-ht	Qo	Qal	Qalb	Qaf			
Alluvium	Qal	Qallt	Qali-ht	Qo	Qal	Qalb	Qaf	Hudson	Holocene	Quaternary
Loess				Qps1	Qps1b					
Eolian Sand				Qps2	Qps6					
Colluvium				Qnw2				Wisconsin		
Outwash	Qnw	Qnw T2	Qnw T1			Qnw3				
Erosion Surface and Glacial Till				Qwa2						
Bedrock				Qwa3			Qbr	Pre-Illinoian		Paleozoic

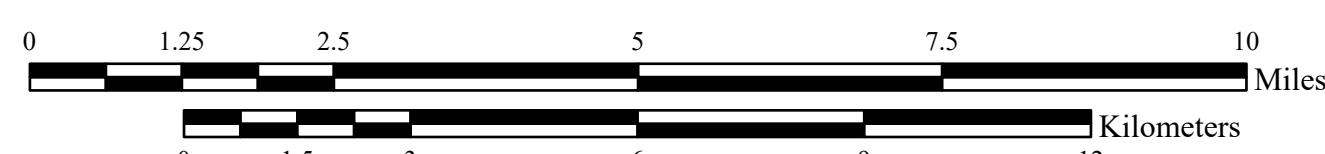
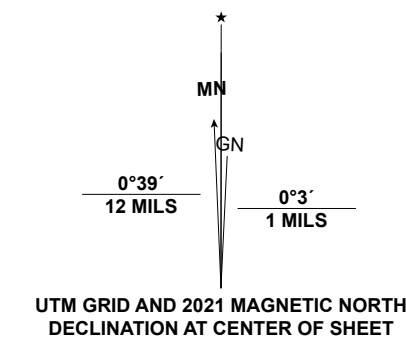
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MAP SYMBOLS

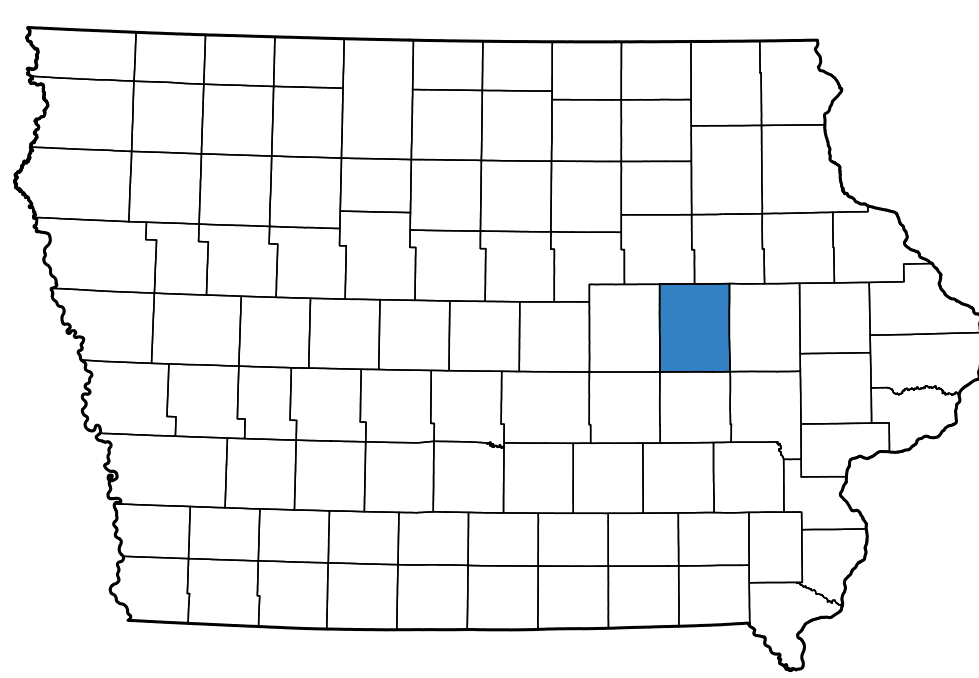
- GeoSam point
 - new drill core
 - hand probe/auger
 - ✕ Quaternary outcrop
 - ▲ geophysics point
 - town boundary
 - cross-section
 - river/stream
- ### ROAD CLASSIFICATION
- Interstate
 - U.S. Route
 - State Route



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. 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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GEOLOGIC CROSS-SECTION A-A'

