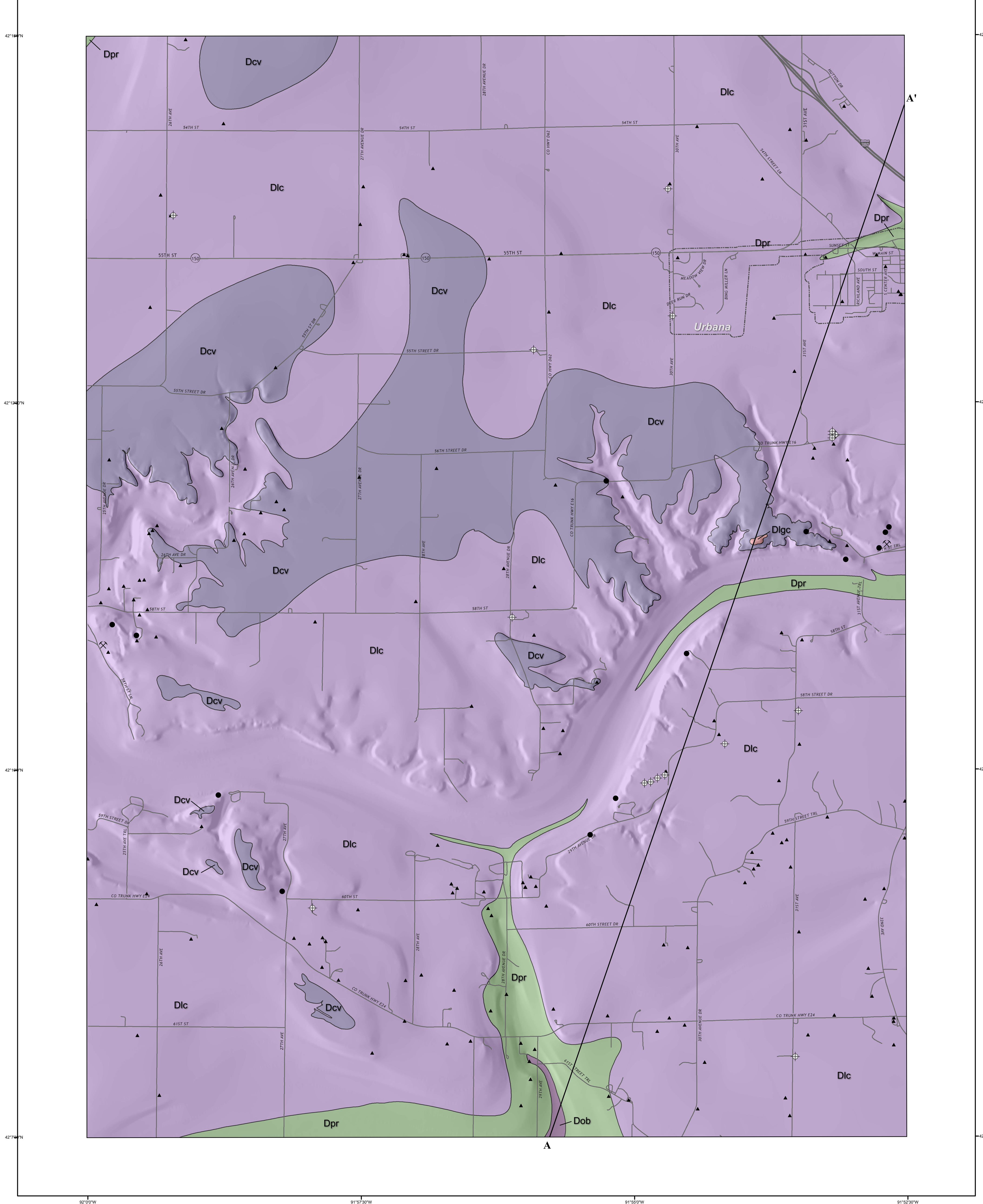
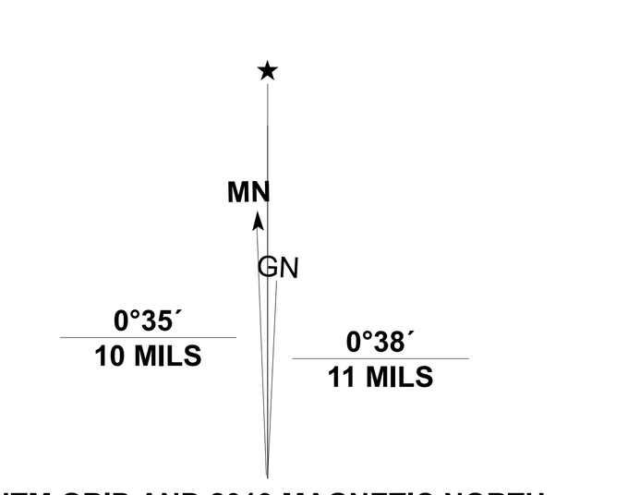
BEDROCK GEOLOGIC MAP OF THE CENTER POINT NW (IOWA) 7.5' QUADRANGLE



1:24,000

0 0.5 1 2 3 4 Miles

0 0.5 1 2 3 4 Kilometers

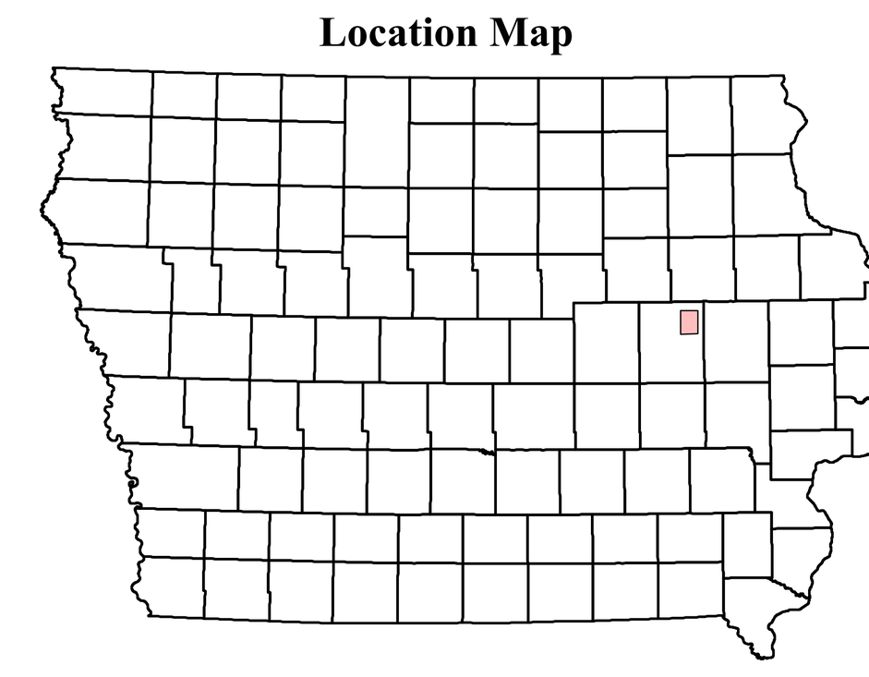


UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Adjacent 7.5' Quadrangles

BRANDON, IOWA	CHENEY, IOWA	WALKER, IOWA
VINTON, IOWA	CENTER POINT NW, IOWA	CENTER POINT, IOWA
VAN HORNE, IOWA	CENTER POINT SW, IOWA	SHELLSBURG, IOWA

Location Map



LEGEND

CENOZOIC

QUATERNARY SYSTEM

Qu — **Qu - Undifferentiated Unconsolidated Sediments** (Quaternary System). The Quaternary deposits consist of loamy soils developed in loess, glacial till, colluvium of variable thickness, alluvial clay, silt, sand, and gravel. These deposits cover most of the land surface except the areas of shallow bedrock along the Cedar River and tributaries. The thickness of the Quaternary deposits usually varies between 8 and 24 m (25-80 ft), with a maximum more than 60 m (200 ft) in deep bedrock valleys in northeast and south center of the quadrangle. This unit is shown only on the cross-section, not on the map.

PALEOZOIC

DEVONIAN

Dlgc — **Dlgc - Limestone, Dolomite, and Shale** (Lithograph City Formation) Middle to Upper Devonian. This map unit has been mostly eroded and occurs only as a small spot on the bedrock surface along the Cedar River valley in the quadrangle. Although thickness of this unit is regionally around 23 m (75 ft), erosional remains of this unit are much thinner than regular in the mapping area. This unit consists of limestone, dolomitic limestone, dolomite, and minor shale. Regionally, this unit is characterized by interbeds of laminated lithographic and sub-lithographic limestone and dolomitic limestone, in part argillaceous. "Birdseye" structures, vugs and calcite vug-fills are common. Some intervals are fossiliferous and stromatoporoid-rich.

Dcv — **Dcv - Limestone and Dolomite** (Coralville Formation) Middle Devonian. This map unit consists of limestone, dolomitic limestone, and dolomite, in part argillaceous or shaly. The thickness of this unit varies between 12 to 21 m (40-70 ft) in the mapping area. Brachiopods, echinoderm debris, and corals are usually found in the limestone facies. This unit mostly occurs at the bedrock surface of the north part of the quadrangle.

Dlc — **Dlc - Dolomite, Limestone, and Shale** (Little Cedar Formation) Middle Devonian. As the dominating bedrock unit, this formation occupies most of the bedrock surface in the mapping area. This unit mostly consists of limestone, dolomitic limestone, and dolomite, slightly argillaceous, and partially laminated and/or cherty. Some minor shale may occur in the upper part of this formation. The thickness of this unit ranges from 27 to 52 m (90-170 ft) in the mapping area. This formation is commonly fossiliferous, and brachiopods and gastropods are especially abundant in the limestone facies.

Dpr — **Dpr – Dolomite and Dolomitic Limestone** (Pinicon Ridge Formation) Middle Devonian. This map unit occurs at the bedrock surface of the deep bedrock valleys in the south-central and northeastern parts of the map. This formation consists of dolomite and dolomitic limestone with varying textures (shaly, laminated, brecciated, sandy, and/or cherty), and occasional evaporites. The thickness of this unit usually ranges from 12 to 24 m (40-80 ft). Compared to other Devonian strata in the mapping area, this formation is usually unfossiliferous.

Dob — **Dob – Limestone and Dolomite** (Otis and Bertram formations) Middle Devonian. This map unit only occurs at the bedrock surface of the bedrock valley in south-central mapping area. These two formations are not differentiated because of lithological similarity and restriction of occurrence. This map unit usually consists of limestone and dolomite, laminated or thick bedded. Sand and shale may occur at the bottom of the unit. The thickness of this unit ranges from 6 to 15 m (20-50 ft) in the mapping area.

SILURIAN SYSTEM

Slpc — **Slpc – Limestone and Dolomitic Limestone** (LaPorte City Formation) upper Llandovery and lower Wenlock. This is a limestone facies that correlates with the upper Hopkinton-lower Scotch Grove formations of the Silurian. These rocks are unconformably overlain by Devonian strata. This formation is dominated by dense, fossiliferous limestone and dolomitic limestone, commonly cherty to very cherty. Minor lithologies include argillaceous to shaly chert residuum at the top of the interval (may be basal Devonian rocks) and green-gray shale. The thickness of the map unit varies and is up to 43 m (140 ft). This unit does not occur at the bedrock surface of the map and is only shown on the cross-section.

OTHER FEATURES

- **New drill holes for this map project**
- **Bedrock outcrops**
- **IGS GEOSAM data points** – records available at www.iowageologicalsurvey.org
- **Incorporated Cities**
- **Quarries**
- **Roads**
- W22170 **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

SRATIGRAPHIC COLUMN

System	Series	Stage	Lithostratigraphic Unit		Map Symbol	Lithology	Thickness (in feet)
Devonian	Upper	Fransian	Cedar Valley Group	Lithograph City Fm.	Dlgc		0-15
Devonian	Middle	Givetian	Cedar Valley Group	Coralville Fm.	Dcv		40-70
Devonian	Middle	Givetian	Cedar Valley Group	Little Cedar Fm.	Dlc		90-170
Devonian	Middle	Givetian / Eifelian	Wapsipinicon Group	Pinicon Ridge Fm.	Dpr		40-80
Devonian	Middle	Eifelian	Wapsipinicon Group	Otis and Bertram fms.	Dob		20-50
Silurian	Wenlockian —?— Llandovery	Sheinwoodian —?— Telychian	LaPorte City Fm.		Slpc		25-140

Lithology Key

- dolomitic limestone/ calcitic dolomite
- dolomite
- limestone
- shale
- lithographic limestone
- breccia

Symbol Key

- argillaceous
- dolomitic
- chert
- sandy
- unconformity
- vugs

BEDROCK GEOLOGIC MAP OF THE CENTER POINT NW 7.5' QUADRANGLE, BENTON COUNTY, IOWA

IOWA GEOLOGICAL SURVEY
OPEN FILE MAP OFM-19-5
JUNE 2019

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INTRODUCTION TO THE BEDROCK GEOLOGY OF THE CENTER POINT NW 7.5' QUADRANGLE, BENTON COUNTY, IOWA

The Center Point NW 7.5' Quadrangle is located in Benton County in central Iowa. In terms of landforms, this area belongs to the southern portion of the Iowan Surface landform region, commonly called the Iowan Erosion Surface. This land surface had been modified by various episodes of erosion before and during the Wisconsin-age glacial events (Prior, 1991). Due to extensive glacial and erosional activities, the landscape of this area is characterized by relatively low topographic relief with common paha ridges and large fieldstones known as erratics, which have a glacial origin.

The land surface of this mapping area is mostly covered by Quaternary sediments, including loess, glacial sediments, colluvium and alluvial deposits. The thickness of the Quaternary deposits usually varies between 8 and 24 m (25-80 ft), with a maximum of more than 60 m (200 ft) in deep bedrock valleys in the northeastern and south-central area of the quadrangle. These unconsolidated Quaternary sediments are undifferentiated in this map. For the detailed Quaternary stratigraphy and distribution, see the surficial geologic map of this quadrangle (Kerr et al., 2019).

Bedrock exposures commonly occur in the valleys along the Cedar River and its tributaries in the mapping area. During the field investigation, previous geologic field work records and shallow bedrock locations from the digital soil surveys in Benton County (Brown & Highland, 1980) provided essential information to delineate potential bedrock outcrops. In the map area, 12 bedrock outcrops including several rock quarries were accessed and studied, which provided important regional stratigraphic information for the bedrock geologic map. Subsurface geologic information was mainly derived from the analysis of water well data stored in the IGS GeoSam database. Within the quadrangle, 187 private and public wells were studied, including 17 holes drilled holes especially for this mapping project. Among these studied wells, 19 have descriptive striplogs with cutting samples which are reposited at the Oakdale Rock Library of the IGS, and three of which were newly logged for this bedrock geologic mapping task. Bedrock stratigraphic information from the surrounding area, including bedrock outcrops, quarries, and well records, was also studied and utilized for this mapping project.

The bedrock surface of the Center Point NW 7.5' Quadrangle is dominated by Devonian strata. Some Silurian deposits also occur on the bedrock surface in a deep bedrock valley across the map area. Paleogeographically, the mapping area is within the Devonian Iowa Basin, a region of thickened shelf carbonate, shale and minor lithologies deposited from the late Eifelian to early Frasnian age (Witzke et al., 1988; Witzke and Bunker, 2006). The Middle and lower Upper Devonian carbonate rocks form the important upper bedrock aquifer in the mapping area (Libra et al., 1984, 1994). Due to its complex sedimentary lithology and depositional environments, the geology, paleoenvironments, paleontology and stratigraphy of the Devonian Iowa Basin have been intensively studied. Recent important studies of the Devonian Iowa Basin are represented by Witzke and Bunker (1984), Anderson (1984), Bunker et al., (1986), Witzke et al., (1988), Day and Bunker (1992), Bunker (1995), Anderson and Bunker (1998), Groves et al. (2008), McKay and Liu (2012), and Day et al., (2006, 2008, 2013). Studies on the regional Silurian stratigraphy and geology include the publications of Witzke (1981a, 1981b, 1992). Several geologic maps at 1:24,000 and 1:100,000 scales have been recently completed in nearby counties. The bedrock geologic map of east-central Iowa (1:250,000; Witzke et al., 2003) and the bedrock geologic map of Iowa (1:500,000; Witzke et al., 2010) have also been completed by the IGS. Results from these geologic studies and bedrock geologic mapping projects provide significant regional geologic information and new data for the present bedrock map.

The bedrock stratigraphic nomenclature and correlation of the Devonian strata for this map follow the stratigraphic framework proposed by Witzke et al., (1988). Six bedrock formations, in descending order, the Lithograph City, Coralville, Little Cedar, Pinicon Ridge, Otis and Bertram formations comprise the bedrock surface of the map area. However, the Otis and Bertram formations are not differentiated in the map because of their lithological similarity and distribution restriction. The Devonian units are underlain by the Silurian LaPorte City Formation. The general lithologic features and thickness of each map unit are shown in the Stratigraphic Column and described in the Legend section of this map.

References:

Anderson, W.I. (ed.), 1984: General Geology of north-central Iowa. Guidebook for the 48th Annual Tri-State Geol. Field Conf., 150 p.
Anderson, R.R., and Bunker, B.J., (eds.), 1998: Fossil shells, glacial swells, piggy smells, and drainage wells: the geology of the Mason City, Iowa, area. Geol. Soc. of Iowa Guidebook No. 65, 71 p.
Brown M.D. and Highland, J.D., 1980: Soil Survey of Benton County, Iowa. U.S. Dept. of Agriculture, Soil Conservation Service, 180 p. with 55 map sheets.
Bunker, B.J., Witzke, B.J., and Day, J.E., 1986: Upper Cedar Valley Stratigraphy, North-Central Iowa, Lithograph City Formation. Geol. Soc. of Iowa Guidebook No. 44, 41 p.
Bunker, B.J., (ed.), 1995: Geology and hydrogeology of Floyd-Mitchell counties, north-central Iowa. Geol. Soc. of Iowa Guidebook No. 62, 169 p.
Day, J., 2006: Overview of the Middle-Upper Devonian sea level history of the Wapsipinicon and Cedar Valley Groups, with discussion of new conodont data from the subsurface Cedar Valley Group of southeastern Iowa. *in* Day, J., Luczaj, J., and Anderson, R., (eds.), New Perspectives and Advances in the Understanding of Lower and Middle Paleozoic Epeiric Carbonate Depositional Systems of the Iowa and Illinois Basins. Iowa Geological Survey Guidebook Series No. 25, p. 3-21.
Day, J., and Bunker, B.J., (eds.), 1992: The stratigraphy, paleontology, depositional and diagenetic history of the Middle-Upper Devonian Cedar Valley Group of central and eastern Iowa. Iowa Geological Survey Guidebook Series No. 16, 195 p.
Day, J., Witzke B., and Bunker, B.J., 2008: Overview of Middle and Upper Devonian Cedar Valley Group and Lime Creek Formation carbonate platform facies, faunas, and event stratigraphy of northern Iowa. *in* Groves, J.R., Walters, J.C., and Day, J., (eds.), Carbonate platform facies and faunas of the Middle and Upper Devonian Cedar Valley Group and Lime Creek Formation, northern Iowa. Iowa Geological Survey Guidebook No. 28, p. 15-39.
Day, J., Witzke B., and Lundy, S., 2013: Aspects of the Paleozoic history of epeiric seas of the Iowa basin. Iowa Geological and Water Survey Guidebook No. 29, 118 p.
Groves, J.R., Walters, J.C., and Day, J., (eds.), 2008: Carbonate platform facies and faunas of the Middle and Upper Devonian Cedar Valley Group and Lime Creek Formation, northern Iowa. Iowa Geological Survey Guidebook No. 28, 96 p.
Kerr, P., Tassier-Surine, S., Liu, H., and Clark, R., 2019, Surficial Geologic Map of the Center Point NW 7.5' Quadrangle, Benton County, Iowa: Iowa Geological Survey, Open File Map OFM-19-6, 1:24,000 scale map sheet.
Libra, R.D., Hallberg, G.R., Ressmeyer, G.G., and Hoyer, B.E., 1984: Groundwater quality and hydrogeology of Devonian-Carbonate aquifers in Floyd and Mitchell counties, Iowa. Iowa Geological Survey Open File Report 84-2, p. 1-106.
Libra, R.D., Quade, D.J., Hallberg, G.R., and Littke, J.P., 1994: Groundwater quality, hydrogeology, and agricultural drainage wells, Floyd and Mitchell counties, Iowa. Iowa Geological Survey Technical Information Series 29, 64 p.
McKay, R.M. & Liu, H., 2012: Cedar Valley Group: the Lithograph City – Shell Rock Formation contact at Mason City, Iowa. Geol. Soc. of Iowa Guidebook No. 90, 12 p.
Prior, J.C., 1991: Landforms of Iowa. University of Iowa Press, Iowa City, 154 p.
Witzke, B.J. and Bunker, B.J., 1984: Devonian stratigraphy of north-central Iowa. Iowa Geological Survey Open File Report 84-2, p. 107-149.
Witzke, B.J. and Bunker, B.J., 2006: Middle shelf facies of the Cedar Valley Group (Devonian) and their stratigraphic relationships in eastern Iowa. *in* Day, J. E., Luczaj, J., and Anderson, R., (eds.), New Perspectives and Advances in the Understanding of Lower and Middle Paleozoic Epeiric Carbonate Depositional Systems of the Iowa and Illinois Basins. Iowa Geological Survey Guidebook Series No. 25, p. 23-46.
Witzke, B.J., Anderson, R.R., and Pope, J.P., 2010: Bedrock geologic map of Iowa (1:500,000). Iowa Geological Survey Open File Map OFM-10-1.
Witzke, B.J., Anderson, R.R., Bunker, B.J., and Ludvigson, G.A., 2003: Bedrock geology of east-central Iowa (1:250,000). Iowa Geological Survey Open File Map OFM-03-2.
Witzke, B.J., Bunker, B.J., and Rogers, F.S., 1988: Eifelian through lower Frasnian stratigraphy and deposition in the Iowa area, central midcontinent, U.S.A. *in* McMillan, N.J., Embry, A.F, and Glass, D.J. (eds.): Devonian of the World. Canadian Soc. of Petroleum Geologists, Memoir 14, vol. I, p. 221-250.

Base map from USGS Center Point NW 7.5' Digital Raster Graphic (IGS GIS file IA_center_point_NW_USGS_topo.tif) which was scanned and modified from the USGS Center Point NW 7.5' Topographic Quadrangle map, published by The US Geological Survey in 2019. Land elevation contours (10' interval). Bedrock topography raster created internally for this map project.

Iowa Geological Survey digital cartographic file USGS_Center_Point_NW_BedrockGeology.mxd, version 6/30/19 (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.

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GEOLOGICAL CROSS-SECTION A-A'