UNIVERSITY OF MINNESOTA
MINNESOTA GEOLOGICAL SURVEY
Harvey Thorleifson, Director

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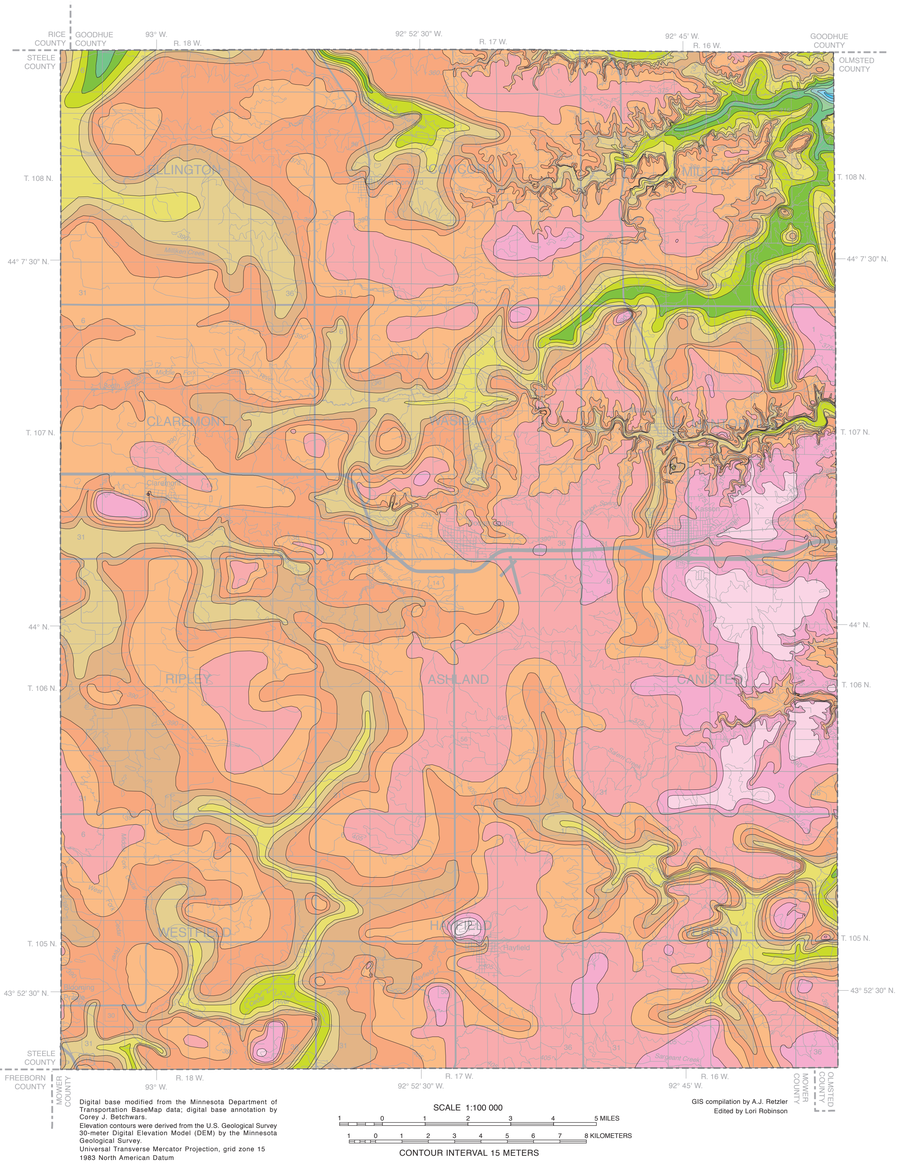
COUNTY ATLAS SERIES
ATLAS C-50, PART A
Dodge County
Plate 6—Bedrock Topography *and*
Depth to Bedrock

BEDROCK TOPOGRAPHY

By

Andrew J. Retzler

2019



EXPLANATION

The bedrock-elevation surface of Dodge County is represented by colors assigned to 25-foot (7.6-meter) contour intervals (example; 901 to 925 feet above sea level) on the Bedrock Topography map. The position of contour intervals was determined from water-well construction records from the County Well Index (CWI), engineering test borings, rotary-sonic drill core, and bedrock outcrop mapping. Passive seismic soundings were used to further constrain the bedrock surface in some areas, most notably across buried bedrock valleys or areas lacking water-well and borings data. Geomorphic features visible on lidar imagery and indicative of near-surface bedrock conditions were also taken into consideration, including prominent steep rocky bluffs, rock-cored mesas, and areas of karst terrain (marked predominantly by sinkholes, stream sinks, and springs within the Karst Feature Inventory Points and Springs in Minnesota GIS datasets provided by the Minnesota Department of Natural Resources, 2018a, b). These features generally suggest shallowly buried bedrock (less than 50 feet [15 meters] of overburden). The patchy distribution of data can be seen on Plate 1, *Database Map*, and should be considered when assessing the reliability of the map at site-specific locations. In general, there is good spatial coverage of water wells and borings reaching the bedrock surface throughout Dodge County; however, the overall density of water wells and borings is notably lower in the less densely populated northwest and southwest portions of the county.

The bedrock elevation of Dodge County ranges from more than 1,250 feet (381 meters) above sea level near the city of Hayfield to less than 900 feet (274 meters) above sea level in the northeast, where the Middle Fork of the Zumbro River crosses into Olmsted County. The average bedrock elevation throughout the county is about 1,150 feet (350 meters) above sea level. The bedrock topography in the eastern half of Dodge County is strongly controlled by present-day drainages that expose numerous bedrock outcrops (most notably several branches of the Zumbro River and Salem Creek) and give that area a markedly sharper, more detailed appearance in comparison to the rest of the county. The bedrock topographic landscape outside of this area is presumably just as defined and intricate; however, thicker overburden, lack of outcrop, and a comparatively sparser subsurface dataset in terms of water wells and borings do not permit capturing such detail. Nonetheless, the data do reveal the presence of several buried bedrock valleys, most notably in the northwest and southwest corners of Dodge County, where they can be traced into adjacent Goodhue and Mower Counties, respectively (Fig. 1, locations A, B). The most prominent bedrock topographic feature of Dodge County is a nearly 18-mile-long (29-kilometer-long), southwest-to-northeast buried bedrock valley. It extends from western Dodge County, just northeast of the city of Claremont, to the northeastern corner along the border with Olmsted County (Fig. 1, location C). The spatial extent of this bedrock valley roughly corresponds to the present-day South Branch Middle Fork of the Zumbro River at its area of highest elevation, and to the present-day Harkcom Creek and Middle Fork of the Zumbro River in its lower elevation. This bedrock valley also meets with another prominent, but shorter, bedrock valley in the northeast that lies within the present-day reach of the Middle Fork of the Zumbro River (Fig. 1, location D).

The resistance of the underlying bedrock to weathering and erosion can greatly affect the shape of the bedrock topography surface. As a result, the expression of the bedrock topography exhibits some correlation with rock units. Weakly cemented sandstone and shale are easily eroded by flowing water, and are subject to mass movement along near-vertical slopes. Limestone and dolostone are more resistant to physical erosion, but prone to chemical weathering in slightly acidic surface-water and groundwater conditions. The flat upland, or plateaus, that dominate the bedrock topographic landscape of Dodge County are mostly underlain by resistant limestone and dolostone of the Ordovician-aged Maquoketa Formation and underlying Galena Group formations.

REFERENCES

Minnesota Department of Natural Resources, 2018a, Karst feature inventory points: St. Paul, Minn., <https://gisdata.mn.gov/dataset/geos-karst-feature-inventory-pts>.

———2018b, Springs in Minnesota: St. Paul, Minn., <https://gisdata.mn.gov/dataset/env-mn-springs-inventory>.

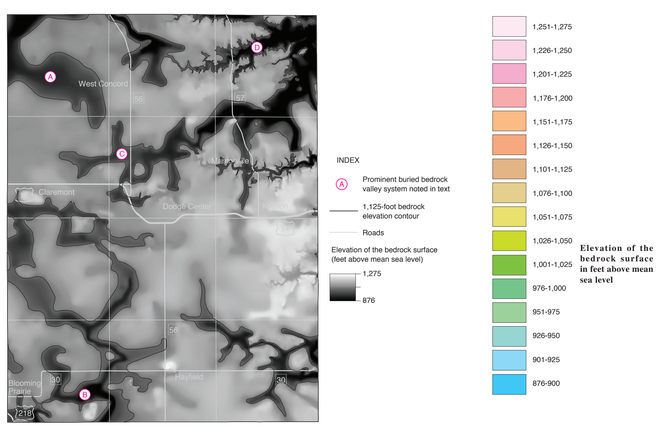


Figure 1. Bedrock-elevation surface of Dodge County shaded to highlight the buried bedrock valley drainage systems. The areas shaded in lighter gray represent a bedrock elevation surface more than 1,125 feet (343 meters) above mean sea level. The prominent buried bedrock valley drainage systems that are noted in the corresponding explanation are highlighted and labeled A through D.

DEPTH TO BEDROCK

By

Andrew J. Retzler

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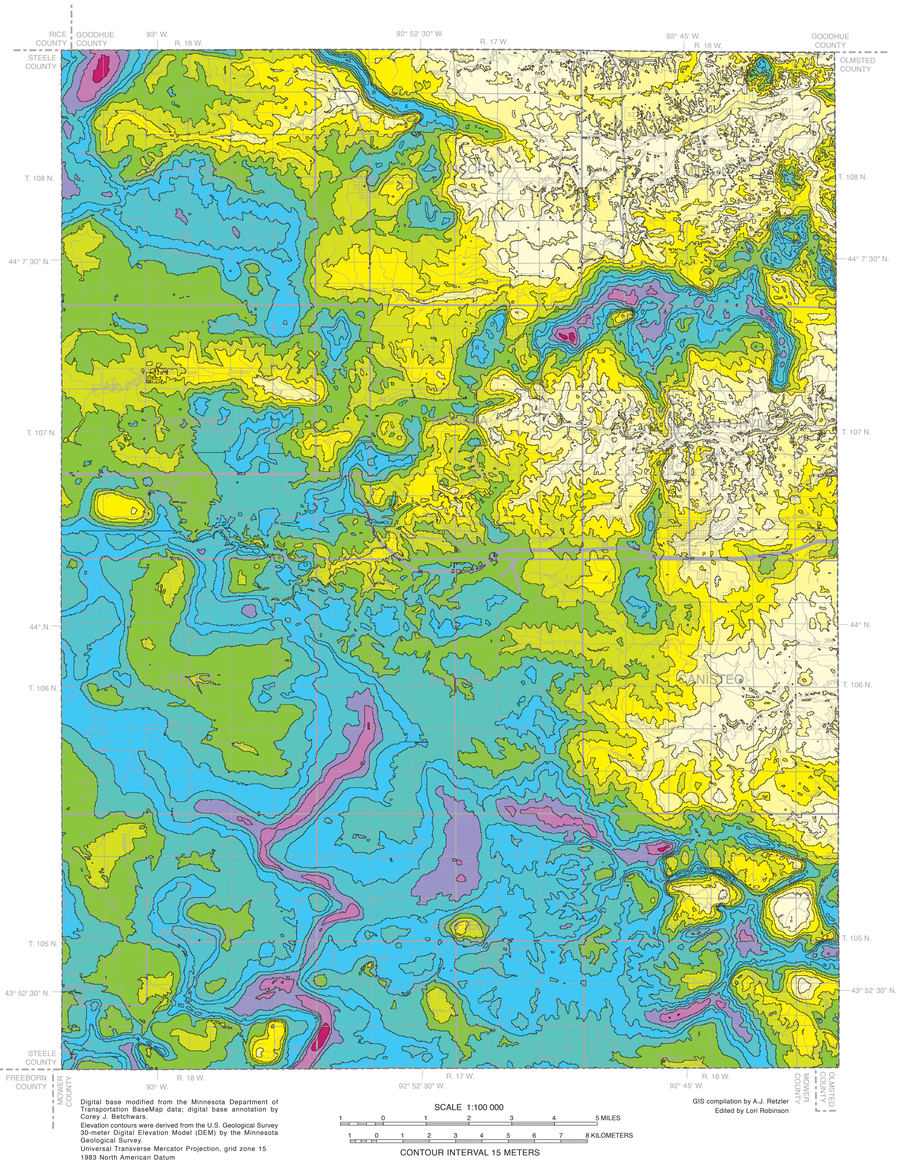

EXPLANATION

The depth to bedrock is equal to the depth from the land surface to the underlying bedrock surface. To calculate this thickness, a grid of bedrock-surface elevations (derived from the Bedrock Topography map) was subtracted from a corresponding grid of land-surface elevations. The surface-elevation grid was resampled from a 1-meter DEM derived from lidar supplied by the Minnesota Department of Natural Resources. The bedrock elevation grid was taken from the Bedrock Topography map, which was interpolated from 25-foot (7.6-meter) contours based on outcrop mapping and interpretation of water-well records, engineering test borings, passive seismic data, and geomorphic features. The residual grid was then classified at a 25-foot (7.6-meter) interval to produce the color-coded Depth to Bedrock map. Thickness of the Quaternary sediments can vary greatly over short distances, and mapping at this scale (1:100,000) may not properly resolve such prominent variations. For this reason, it is best to consult site-specific data (such as water-well records, engineering test borings, and passive seismic soundings) wherever available. The detailed appearance of the Depth to Bedrock map is related to surficial landforms because the land-surface topography model is based on higher-resolution data than the interpreted bedrock-surface model.

The thickest sediments in Dodge County are within the buried bedrock valley systems, where the depth to bedrock is as much as 275 feet (167 meters). These systems are highlighted in Figure 1 of the Bedrock Topography map. In general, depth to bedrock increases to the west across Dodge County. Areas where bedrock is at or within 50 feet (30 meters) of the land surface are in the eastern portion of Dodge County, most notably atop carbonate rock plateaus of the Galena Group formations within the drainage valleys of the Middle Fork and South Branch Middle Fork of the Zumbro River and Salem Creek. These areas coincide with karst terrain, marked by mapped sinkholes, stream sinks, and springs within the Karst Feature Inventory Points and Springs in Minnesota GIS datasets provided by the Minnesota Department of Natural Resources (2018a, b; Fig. 1). The Minnesota Department of Natural Resources will continue to add to and refine the Karst Features and Springs GIS datasets as they construct Part B of the Dodge County Geologic Atlas that includes maps of water levels in aquifers, direction of groundwater flow, water chemistry, and sensitivity to pollution.

REFERENCES

Minnesota Department of Natural Resources, 2018a, Karst feature inventory points: St. Paul, Minn., <https://gisdata.mn.gov/dataset/geos-karst-feature-inventory-pts>.

———2018b, Springs in Minnesota: St. Paul, Minn., <https://gisdata.mn.gov/dataset/env-mn-springs-inventory>.

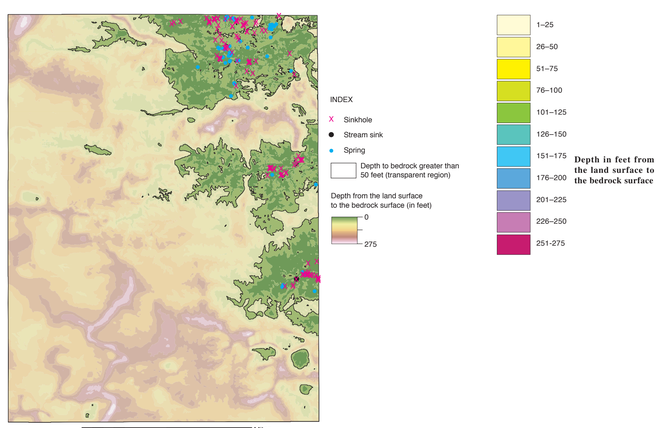

Figure 1. Depth to the bedrock surface in Dodge County shaded to highlight the areas to the east in which the depth to bedrock is less than or equal to 50 feet (15 meters). The location of sinkholes, stream sinks, and springs provided by the Minnesota Department of Natural Resources (2018a, b) at the time of this publication are shown to illustrate the correspondence between these relatively shallow depth to bedrock areas and karst terrain features. The presence and location of these karst terrain features are subject to change as efforts to field-verify and update these datasets by the Minnesota Department of Natural Resources are ongoing.

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GEOLOGIC ATLAS OF DODGE COUNTY, MINNESOTA