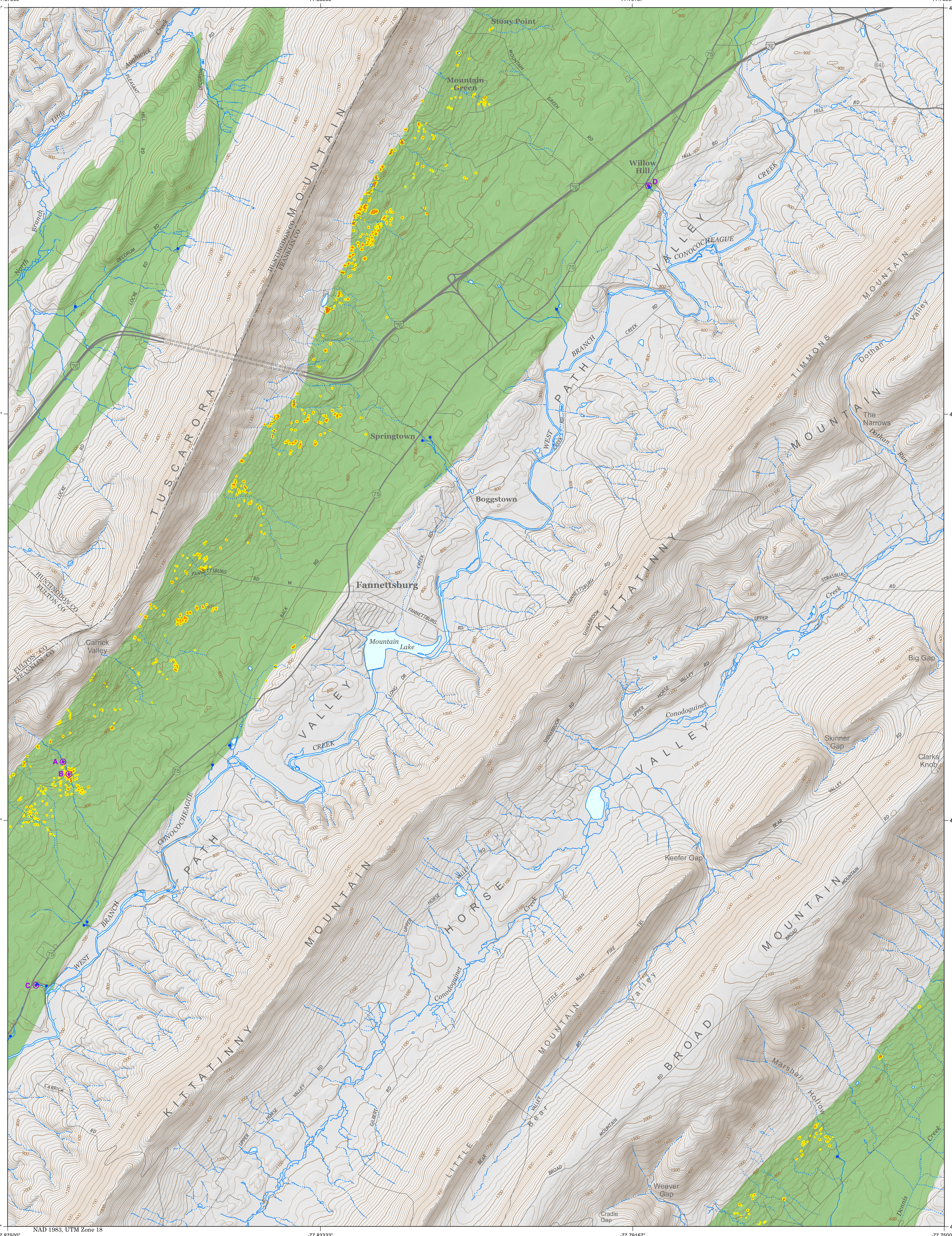


Areas of carbonate bedrock based on field mapping by Aaron D. Bierly, 2013–15 and 2020.

Closed depressions and sinkhole localities interpreted from hillshade and selected field checks by Aaron D. Bierly, 2014–15.

Water bodies and flowpaths modified from preliminary data created by Ellen Fehrs of the Pennsylvania Geological Survey in 2022 for the Pennsylvania Hydrography Dataset (PAHD) using QL2 lidar elevation data collected for the U.S. Geological Survey in 2019 and distributed through PASDA at http://www.pasda.psu.edu/.

Digital map production by Caron E. Pawlicki and Aaron D. Bierly, Pennsylvania Geological Survey, 2022–23.

SCALE 1:24 000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

$10\frac{1}{2}°$ TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2023

Base map modified from *USGS Topo Map Vector Data (Vector) 14979 Fannettsburg, Pennsylvania 20190920 for 7.5 x 7.5 minute FileGDB 10.1,* which was published by the U.S. Geological Survey, National Geospatial Technical Operations Center, on September 20, 2019.

Hillshade created from DEMs derived from lidar elevation data collected for the Pennsylvania Geological Survey PAMAP program in 2007 and distributed through PASDA at http://www.pasda.psu.edu/.

A perennial stream (foreground) flowing off the east side of Tuscarora Mountain disappears (goes subterranean) down a fracture in the dolostone bedrock. The dry streambed in the background can be traced downslope for 0.17 mi beyond this point (see photograph B1).

Coordinates: 40.04744°, -77.86745°

Pinnacle development in the Bellefonte Formation on the northern side of Path Valley. Note the dry streambed with a tree growing out of it in the middle foreground of the photograph. Ephemeral streams in karst terrains often only flow during torrential rain events.

Coordinates: 40.04626°, -77.86681°

Land managers should be aware of these natural drainageways and avoid building in close proximity.

A recent sinkhole on the northern side of Path Valley within the Bellefonte Formation. This sinkhole is approximately 6 ft deep and 8 ft in circumference. Its walls are composed of carbonate residuum. The bedrock throat was not observed in the bottom of the sinkhole. Note the undeveloped and natural landscape around the sinkhole.

Coordinates: 40.04626°, -77.86681°

Sinkholes are a hazard to infrastructure stability and public safety. It is highly recommended that any future development in the sinkhole-prone areas of the Fannettsburg quadrangle includes a thorough subsurface investigation and water-runoff plan to mitigate increasing the occurrence and density of these sinkhole hazards.

A spring full of watercress emerging from a limestone outcrop of the Chambersburg Formation. An abandoned springhouse captures a second spring approximately 25 ft southeast of this location. Both springs are at the headwater of a perennial tributary to West Branch Conococheague Creek.

Coordinates: 40.02473°, -77.87096°

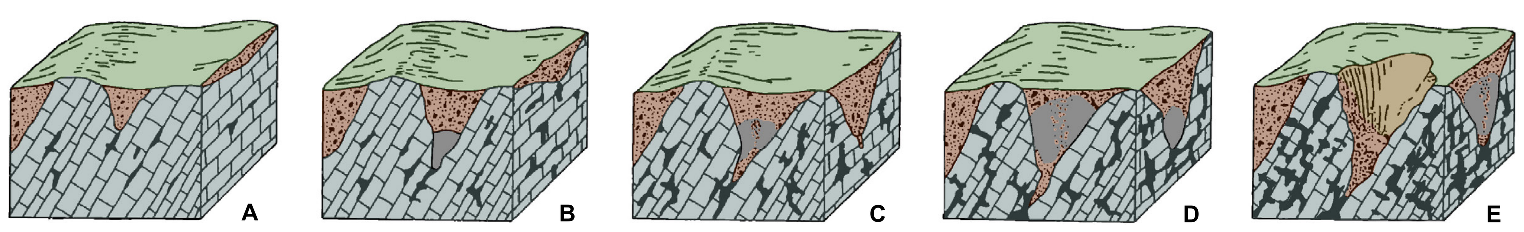
Two springhouses constructed of limestone at Willow Hill. The springs are producing from the Chambersburg Formation. The springhouse to the right marks the headwater of a perennial tributary to West Branch Conococheague Creek that runs parallel to portions of Steck Road and Creek Road.

Coordinates: 40.10681°, -77.78965°

SYMBOLS

Sinkhole or Closed Depression — Area of feature is shown in orange.
Carbonate Bedrock
Open Water — Lake, pond, or wide stream.
Streams: Perennial, Intermittent, Ephemeral
Spring — Tail points in direction of flow.
Location of photograph

Sequential Development of a Sinkhole



The sequential geological development of a sinkhole, as modified from Geyer and Wilshusen (1982, Fig. 6, p. 8) and shown above, is as follows: **A.** Over a long period of time, chemical erosion from acidic water forms an irregular bedrock surface and develops dissolution channels along bedding planes and joint fractures in limestone- and dolostone-dominant formations. These channels become conduits for transporting water, which is eventually discharged at the surface as springs. **B.** Continued chemical erosion forms a void in the bedrock, and overlying compacted surficial sediments and soils form a bridge over the void. **C.** The bridge begins to erode. Reasons for bridge erosion include fluctuations in water tables, changes in surface drainage, heavy rain events, and strong vibrations. **D.** As erosion continues, the center of the bridge thins significantly. **E.** The bridge thins to the point that it cannot hold its own weight and collapses, forming a sinkhole.

REFERENCE

Geyer, A. R., and Wilshusen, J. P., 1982, Engineering characteristics of the rocks of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Environmental Geology Report 1, 300 p.

RECOMMENDED READING

Kochanov, W. E., 2015, Sinkholes in Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Educational Series 11, 30 p.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under STATEMAP award numbers G13AC00233, 2013, and G14AC00168, 2014.

This plate is part of Map 23–07.0, a publication of the Pennsylvania Geological Survey. In addition to being reviewed by staff at the Survey, it received two external peer reviews. The publication includes a PDF file of the map plate and a GIS file geodatabase containing the geologic data used to create the map. A bedrock geologic map and a surficial geologic map of the Fannettsburg quadrangle have also been published (Map 23–05.0 and Map 23–06.0, respectively). Links to download these reports are in the Survey's list of publications, which is available at https://www.dcnr.pa.gov/Geology/PublicationsAndData/Pages/default.aspx.

Orbisonia	Shade Gap	Doylesburg
Burnt Cabins	Fannettsburg	Roxbury
McConnellsburg	Saint Thomas	Chambersburg

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ADJOINING 7.5-MINUTE QUADRANGLES

DISTRIBUTION OF SINKHOLES AND KARST-RELATED CLOSED DEPRESSIONS WITHIN THE FANNETTSBURG 7.5-MINUTE QUADRANGLE, FRANKLIN, FULTON, AND HUNTINGDON COUNTIES, PENNSYLVANIA

BY
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PENNSYLVANIA GEOLOGICAL SURVEY

2023

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DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES