Description of Map Units

Quaternary

ml — **Modified Land deposits**
Areas where surficial deposits are known to have been modified by human activity and can longer be reliably determined. Includes areas large enough to be shown at map scale but does not include local disturbances (e.g., changes on individual private housing lots) or relatively shallow and obvious disturbances such as parking lots and retail areas. An example includes the stream restoration along an unnamed tributary to the Sassafras River where geologic material has been removed, replaced, and redistributed.

Qm — **Tidal Marsh deposits**
Interbedded sand, silt, and clay that is rich in organic matter. Thickness is generally less than 30 feet.

Qal — **Alluvium**
Stream deposits, consisting of sand, silt, and clay, gravel and organic matter. Locally contains boulders and other colluvial deposits; may include some swamp deposits and minor tidal marsh deposits. Thickness generally less than 40 feet.

Qzf — **Lowland deposits, fine grained facies**
Yellowish brown, thin-bedded, fine-grained sand and silt. Commonly micaceous and glauconitic. In the Cecilton quadrangle it is mapped in a few areas along the north shore of Great Bohemia Creek. Equivalent to the fine-grained facies of the Talbot formation of Conant (1990). Lowland deposits typically occur at elevations less than 40 ft and is less than 50 feet thick.

Tertiary

Tp — **Pensauken Formation**
Light yellow to orange-tan, in places oxidized to deep reddish brown, feldspathic, fine- to coarse-grained, cross-bedded sand, with thin- to thick beds of gravel. Base of formation characterized by gravelly channel-lag deposits. Upper part of formation is generally a fine- to medium-grained sand and loam, but may include gravelly beds and stringers. Detrital clasts include vein quartz, crystalline rocks, sandstone and siltstone. Thickness is between 0 and 65 feet.

Ta — **Aquia Formation**
Fine- to medium-grained, glauconitic quartz sand, clayey in places, dark to light green and yellow where fresh, weathers to yellow brown and dusky dark orange. Thickness ranges from 0 up to possibly 50 feet in the southeastern part of quadrangle.

Th — **Hornerstown Formation**
Fine- to medium-grained, silty and clayey, glauconitic sand; very dense. Olive-black, dusky green or olive-gray where unweathered. Glauconite comprises 60 to 90 percent of sand; dark green polylobate grains, with few altering to limonite. Glauconite grains tend to be smooth, rounded, and single with few compound or accordion-shaped grains. Interstitial clay is green and glauconitic; typically unfossiliferous, Thickness is approximately 20 feet.

Cretaceous

MONMOUTH GROUP

Ks/Kml — **Severn and Mount Laurel Formations, undifferentiated**
Variably glauconitic, quartz sand. Undifferentiated in map view.

Ks — **Severn Formation** *(subsurface only)*
Silty, feldspathic, variably glauconitic, quartz sand; olive-black to olive-brown. Basal part (8-10 ft) of unit may be mistaken for Hornerstown but Severn glauconite bed tends to contain abundant coarse (up to granule size) aggregates and more accordion-shaped grains intermixed with coarse quartz sand in a gray clayey matrix. Borings common throughout, about 1 inch in diameter; especially abundant toward the top of the unit. Indurated layers in places; some siderite concretions. Thickness up to approximately 80 ft.

Kml — **Mount Laurel Formation** *(subsurface only)*
Fine- to medium-grained, variably glauconitic, quartz sand. Sand is shelly and calcareous in places. Medium light gray to light olive gray where unweathered; some sand nearly white or salt-and-pepper; varying to yellow, brown, and red with weathering and/or iron staining. Generally less glauconitic than Severn. Sporadic siderite concretions. Common fossils include *Belemnitella americana* and *Exogyra cancellata*. Thickness is up to approximately 80 feet.

MATAWAN GROUP

Kmt — **Marshalltown Formation**
Fine silty sand, greenish black, heavily glauconitic, up to 90 percent glauconite. Glauconite grains are dark green and polylobate. Thickness about 18 feet.

Ket — **Englishtown Formation**
Fine to medium, silty sand, micaceous, glauconite bearing, lignite bearing, olive gray and dark yellowish brown. In places, partially lithified with limonite cement. Genrally coarsens upward from underlying Merchantville. Maximum thickness about 15 feet in northwestern portion of quadrangle, thins and becomes more silty or is absent in southeastern portion of quadrangle.

Kmv — **Merchantville Formation**
Very fine, silty and clayey micaceous and glauconitic sand. Medium dark gray to dark gray. Becomes very dense and more clayey with depth. Thickness 40 to 50 feet.

Kmg — **Magothy Formation**
Fine to medium quartz sand, white to light gray and buff. Lignitic in places with flattened carbonized logs present. Also, black to dark gray clays and silty sands. Sands cross-stratified in places. Light gray to light pinkish gray stiff plastic clay present just below contact with overlying Merchantville. Thickness ranges from 40 to 55 feet in the quadrangle.

Kp — **Potomac Group**
Layers and lenses of quartzose sand and gravelly sand, silt and clay. Variably micaceous. Sands typically brown to yellow-brown with planar or cross stratification. Clays and clay-silts are dense, multicolored red, brown, purple, gray; often mottled. In places, dark gray clays may contain carbonized plant fossils, lignite, and carbonized logs. Thickness ranges from about 1,000 feet in the northwestern part of the Cecilton quadrangle to 1,500 feet in the southeastern part.

Explanation of Map Symbols

A —— A′ Cross section line

Paleochannel boundary line

Geologic Contacts

Identity and existence certain

Identity and existence inferred

Identity or existence questioned

Other Features

Borehole or well

D16 Auger hole (Conant, 1990)

16 Tp / 39 Ks/Kml +54 — Numbers on left are thickness of stratigraphic unit in feet. Numbers on the right are approximate elevation of contact in hole, in feet

Base Map Symbols

Transportation

Primary highway, divided by median strip

Primary route, class 1 (divided, lanes separated)

Primary route, class 1 (undivided)

Secondary route, class 2

Light duty road or street, class 3

Topography

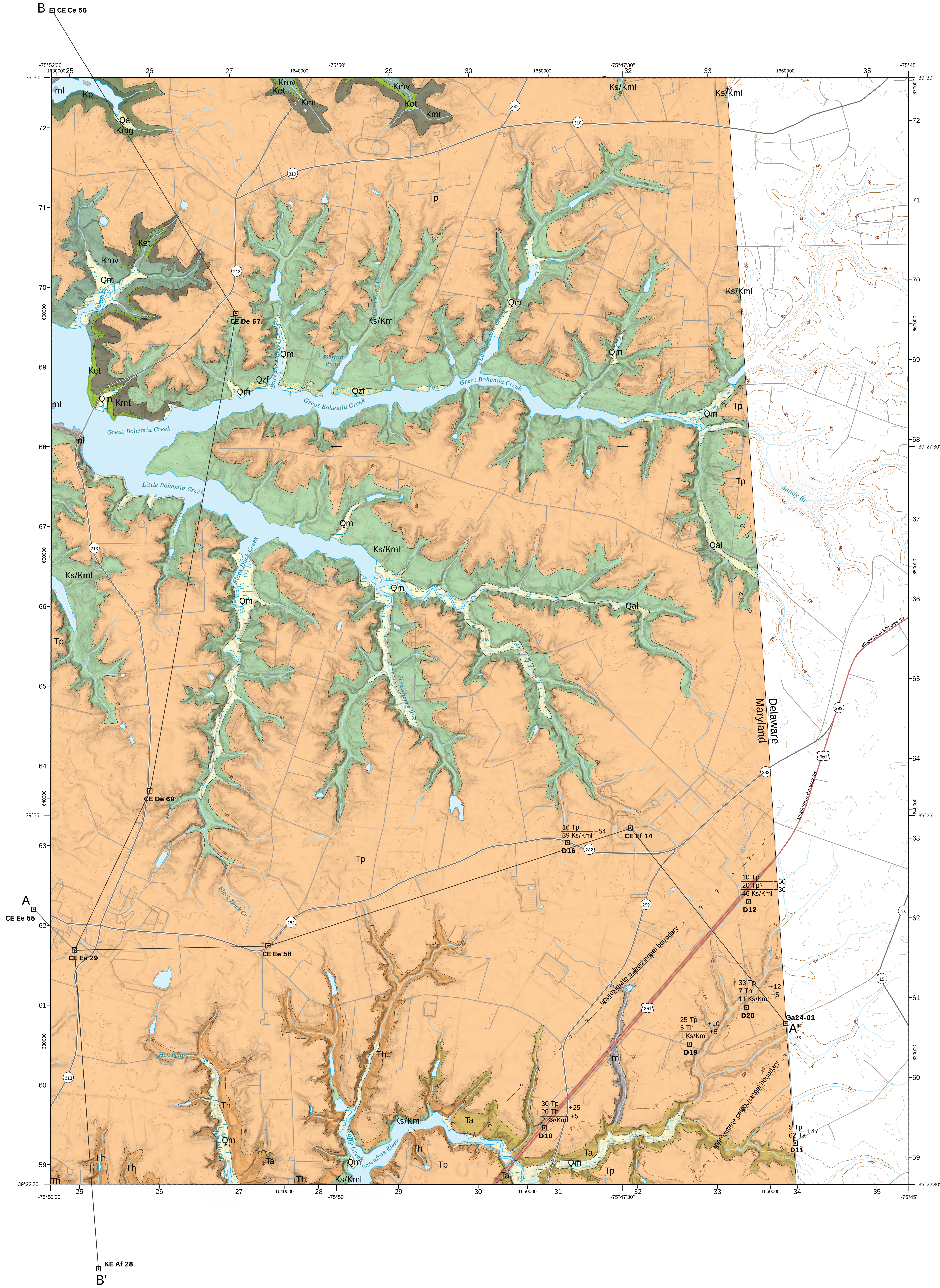
Topographic index contour (50-ft interval)

Topographic intermediate contour (10-ft interval)

Hydrography

Muddy Creek — Stream

Deep Lake — Water body (e.g. lakes, ponds, rivers)



Discussion

The Cecilton quadrangle lies predominantly in Maryland on the northern flank of the Salisbury Embayment in the Atlantic Coastal Plain Province. The region is locally known as the upper Eastern Shore of Maryland because it is the northern section of Maryland's Coastal Plain that lies east of the Chesapeake Bay. The Salisbury Embayment is an open to the east, down-warped sedimentary basin. Sediments in the embayment range in age from Triassic to Holocene. These sediments thicken from a few feet in the Fall Zone, the boundary between the Piedmont Plateaus Province and the Coastal Plain Province, to over 7,000 feet at Ocean City, Maryland.

Basement rocks do not crop out in the quadrangle but were penetrated at a depth of 1,358 feet below sea level in drill hole CE Ee 29 in southwest quadrant of the quadrangle at the town of Cecilton. Drill cuttings recovered from the bottom of CE Ee 29 include saprolite and schist or gneiss (Otton and Mandle, 1984). These rocks are similar to the schist and gneiss outcropping to the west in the eastern Piedmont of Maryland and indicate that Piedmont rocks continue eastward under the Coastal Plain (Hansen and Edwards, 1986). Depth to basement ranges from about 1,000 feet below sea level in the northwest corner of the Cecilton quadrangle to about 1,500 feet below sea level in the southeast corner.

In the Cecilton quadrangle, exposed sediments range from Cretaceous to recent. Sands and clays of the Lower to Upper Cretaceous Potomac Group are exposed in the northwest corner of the quadrangle. The predominantly sandy upper Cretaceous Magothy Formation overlies the Potomac Group sediments. Work by Norville (2022) focusing on detailed lithology and pollen biostratigraphy of the core from CE De 67 suggests that locally there may be a thin (approximately 12 ft thick) interval of a unit characterized by dark clay, muddy sands and sandy muds, tentatively assigned to the Cheesequake Formation, that lies between the Magothy Formation and the Merchantville in the subsurface below Bohemia State Park. Further work will need to be done to confirm the existence and extent of this unit in the Cecilton area.

Going up-section stratigraphically, overlying the Magothy (or the Cheesequake, if present) are the upper Cretaceous units, the Merchantville, Englishtown, Marshalltown, Mount Laurel, and Severn Formations.

The Merchantville, Englishtown, and Marshalltown are considered part of the Matawan Group. All of these units contain glauconite and fossils which provide evidence of marine deposition.

Conant (1990) mapped the Englishtown and overlying Marshalltown as one unit undifferentiated on the Cecil County geologic map because of the difficulty of finding good exposures of the Englishtown in the Cecilton and Earleville quadrangles. Although good exposures are still difficult to find, the subsurface data obtained from the project drilling allowed an inferred (dashed) contact line to be drawn between the Englishtown and Marshalltown Formations with some confidence pending further fieldwork in the region.

Originally only the Mount Laurel Formation of the Monmouth Group was recognized in Cecil County. Conant, who conducted field mapping between 1966-1972 in Cecil County (1990) reported some apparent variation in thickness of the Mount Laurel and suggested local downwarping or embayment that resulted in thicker accumulation of sediments. He indicated that it was likely that some younger units in the Monmouth Group might occur in the county. Wilson (2006) interpreted some of this interval of heavily glauconitic sands to be part of the Severn Formation and in the subsurface identified it separately.

These Upper Cretaceous units and the overlying Tertiary Hornerstown and Aquia Formations exhibit a general southwest-northeast trending strike, and a regional dip to the southeast.

Conant (1990) noted that the Hornerstown and portions of the Monmouth can be misidentified initially due to glauconite-rich beds in both. One lithologic distinction is that glauconite in the Hornerstown Formation is characterized by mostly smooth, rounded, single grains in contrast to the more common compound grains and accordion-shaped grains found in the Monmouth sediments in the Bohemia Mills area on the eastern side of the Cecilton quadrangle.

Much of the upland surface is covered by sand and gravelly sands identified as the Pensauken Formation. The Pensauken has truncated and capped the gently dipping older units over much of the quadrangle. Conant (1990) notes that the base of the unit is irregular while the upper surface is relatively flat. The Pensauken forms a broad gravelly sand sheet that averages about 15 to 25 feet thick, except in the southeast part of the quadrangle south of Warwick where the Pensauken thickens to about 70 feet along a northeast-southwest trending paleochannel.

The name Pensauken Formation is retained here following nomenclature of earlier mappers and their correlations to the Pensauken Formation in New Jersey, however, the structural relationships and age of this unit in Maryland have been disputed. It has been recognized by previous workers (e.g., Conant, 1990) that the unit is equivalent to the Columbia Group in Delaware.

Owens and Minard (1979) claimed a Tertiary age for the Pensauken Formation based upon pollen found in a black clay bed that reportedly interfingered with Pensauken sediments down dip in the southern Delmarva Peninsula and, more specifically, Owens and Denny (1979) designated a late Miocene age based on the reported interfingering with fossiliferous beds of the so-called "Yorktown-Cohansey?" which were considered late Miocene. They interpreted the unit as ancient river deposits of the ancestral Delaware River system that flowed across the Delmarva Peninsula in the late Tertiary. In Delaware, where the Columbia Formation is considered Pleistocene in age, the unit is considered likely the result of glacial dam-burst floods (Tomlinson and Ramsey, 2020; Spoljaric, 1967). Further work will be needed to resolve these stratigraphic discrepancies.

Along the present shoreline in Cecil County, there are some low lying fluvial to estuarine deposits formerly identified as Lowland deposits. The informal name of Lowland deposits, Qz, is used on this map for deposits previously mapped as the Talbot Formation, a name currently in disuse. The relationships between Lowland deposits and the Kent Island Formation (McCartan 1989a, 1989b; Owens and Denny, 1979) as well as some Quaternary terrace deposits are not clearly defined. Until further study reveals the correlation of these units, the informal name of Lowland deposits is applied to identify the former Talbot sediments in this map area. Conant (1990) mapped both a coarse-grained facies and a fine-grained facies in Cecil County; however, in the Cecilton quadrangle only the fine-grained facies is identified.

Quaternary alluvium and tidal marsh deposits are common along streams and tidal rivers. The extent of marshes and alluvium were largely derived from aerial photography.

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Open-File Geologic Map of the Maryland Portion of the Cecilton Quadrangle, Cecil and Kent Counties, Maryland

by John M. Wilson, Heather A. Quinn, and Andrew W. Staley

2023

Supplemental Information:
Cartography and edits by Rebecca Kavage Adams, Bryan Nicholson and William K Vincett III, Maryland Geological Survey (MGS).

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Drilling at the Bohemia River State Park would not have been possible without the cooperation of the Maryland Park Service, in particular Lesley Leader; and the collaboration with the Delaware Geological Survey (DGS), in particular Paul S. McCreary who coordinated the drilling, and DGS project personnel and students who assisted in fieldwork, data analysis, and/or discussion including Peter P McLaughlin Jr., Kelvin W Ramsey, Jaime L Tomlinson, June A Hazewski, R Caleb Norville, and William K Vincett III.
MGS personnel who assisted in fieldwork included Johanna Gemperline, Isabel Glasman, and Thomas Ulizio.

Geologic field mapping conducted in 2004-2006 and 2021-2023.

MD DNR Publication No: DNR 12-120823-1

Version: CECIL2023.OF

Map available as printable PDF and GIS data from the website: http://www.mgs.md.gov/

Maryland LiDAR Statewide - Slope RGB (2019) service from Maryland iMAP

U.S. Geological Survey (USGS) US Topo TNM Cecilton, MD quadrangle, 2023

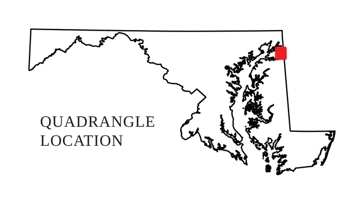
Coordinate System: NAD 1983 (2011) StatePlane Maryland FIPS 1900 (US Feet)
Projection: Lambert Conformal Conic
Horizontal Datum: North American Datum 1983 (2011)

Geographic coordinates (latitude-longitude) shown near corners
1,000-meter grid: Universal Transverse Mercator, Zone 18
10,000-foot ticks: Maryland State Plane Grid

11° 27′ — APPROXIMATE MEAN DECLINATION, 2023

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1988



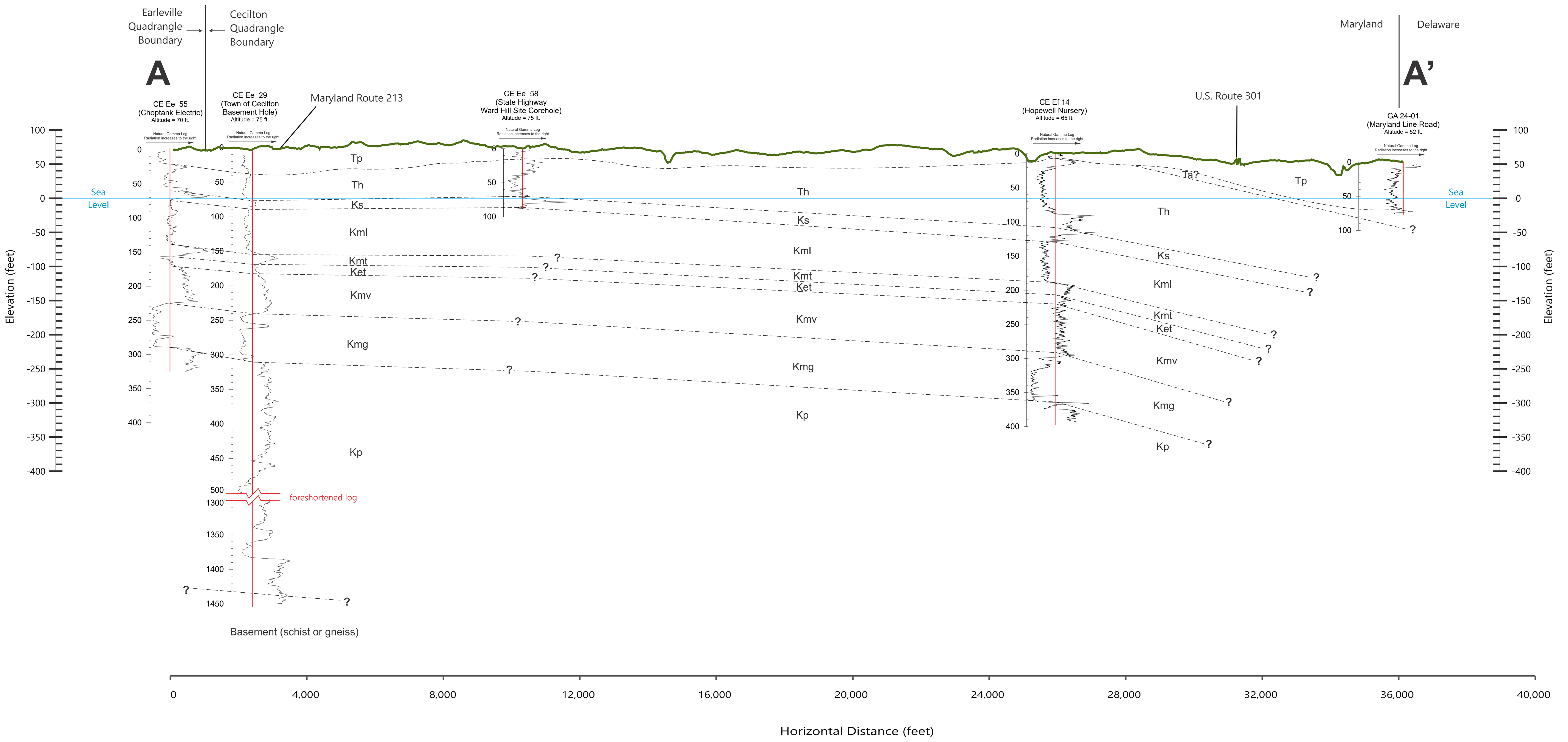
1	2	3
4		5
6	7	8

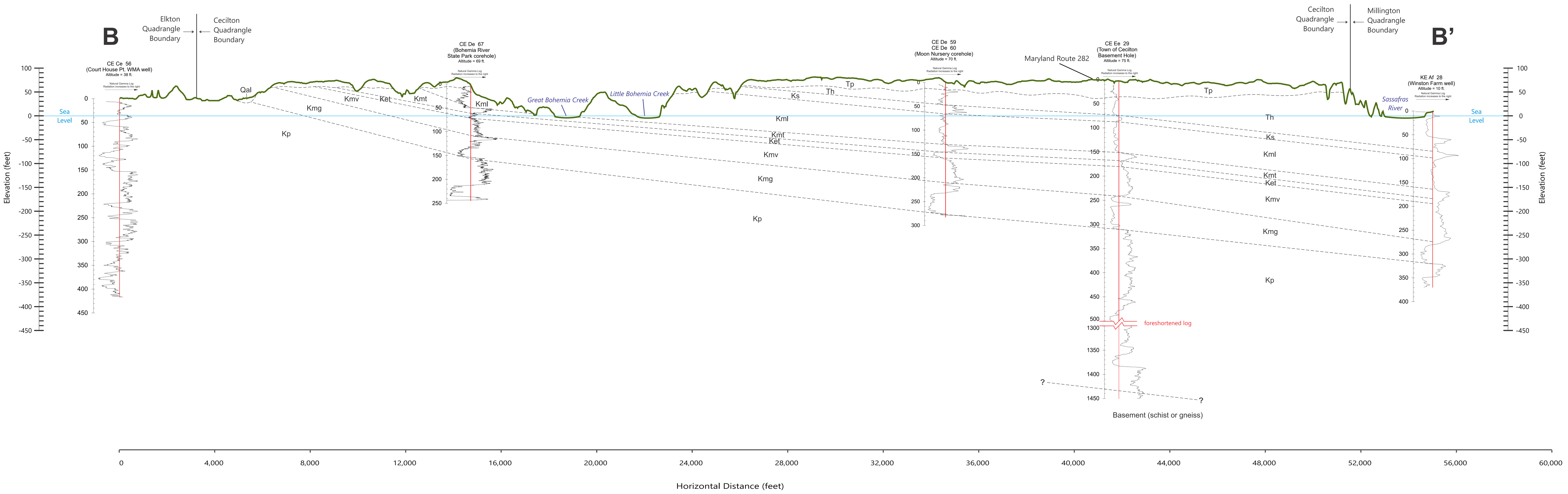
1. North East
2. Elkton
3. Saint Georges
4. Earleville
5. Middletown
6. Galena
7. Millington
8. Clayton

Adjoining 7.5' quadrangle names (Cecilton quadrangle shaded)

State of Maryland
Wes Moore
Governor
Aruna Miller
Lieutenant Governor

Department of Natural Resources
Josh Kurtz
Secretary
David M. Goshorn, PhD.
Deputy Secretary
Maryland Geological Survey
Stephen Van Ryswick
Director





Geologic Cross Sections

Data from several deep coreholes in the quadrangle were integrated and correlated with other subsurface data to support mapping and underlying stratigraphy of the Cecilton quadrangle. Two coreholes, CE De 60 and CE Ee 58, were drilled in 2004 as part of Wilson's initial quadrangle mapping. Corehole CE De 67, at Bohemia River State Park, was drilled in partnership with the Delaware Geological Survey in 2021 to help clarify regional stratigraphy. Detailed work on a portion of the Cretaceous interval of that core was conducted by Robert Caleb Norville at the University of Delaware (Norville, 2022; Norville and McLaughlin, 2022). These data along with additional well and borehole data were used to construct two cross-sections through the Cecilton quadrangle.

Section A-A' runs west to east, beginning with core hole CE Ee 55 on the western side of Cecilton just west of the map boundary (located in the Earleville quadrangle). It includes CE Ee 58. The eastern end of this cross section passes through a portion of the possible Pensauken paleochannel identified by Conant (1990) and crosses the Maryland - Delaware border into part of the quadrangle that lies in New Castle County, Delaware.

Section B-B' starts to the north of the Cecilton quadrangle in the adjacent Elkton quadrangle and runs southward along the western side of the quadrangle. This cross section includes the corehole at Bohemia River State Park (CE De 67) and CE De 60.

The cross-sections are keyed into natural gamma logs of the boreholes and the datum used is sea level. Gamma log deflections to the right indicate increasing gamma radiation, and in general, the greater the gamma log response, the more clayey, or higher content of gamma-ray emitting minerals such as glauconite or uranium-bearing phosphate nodules are present in the sediment. The differing gamma response with depth makes the gamma log a useful tool in correlating the units in the subsurface as different units can have characteristic gamma-log signatures because of their mineralogy.

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MD DNR Publication No: DNR 12-120823-1

Version: CECIL2023.OF

Map available as printable PDF and GIS data from the website: http://www.mgs.md.gov/

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Lieutenant Governor

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