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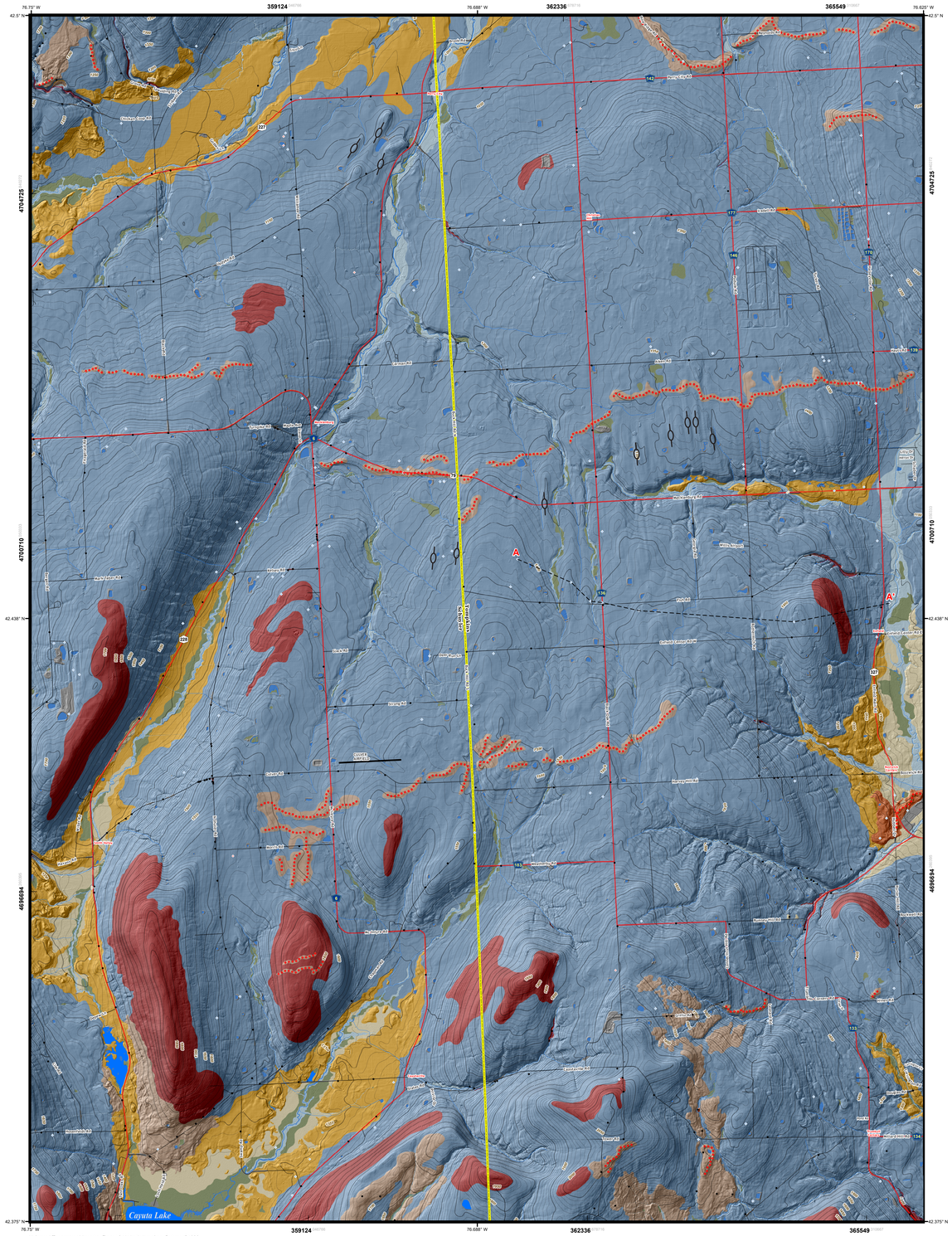
SURFICIAL GEOLOGY OF THE MECKLENBURG 7.5-MINUTE QUADRANGLE, SCHUYLER AND TOMPKINS COUNTIES, NEW YORK

prepared by
Karl J. Backhaus

Supported in part by the U.S Geological Survey Cooperative Agreement Numbers G20AC00418 and G22AC00366
National Cooperative Geologic Mapping Program (STATEMAP)



Universal Transverse Mercator, Zone 18 N North American Datum of 1983

Planimetry layers from the New York State DOT Raster Quadrangle separates for Schuyler and Tompkins Counties (https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=108).

Geographic data layers from 2019 TIGER/Line shapes for transportation and hydrography (https://www.census.gov/cgi-bin/geo/shapefiles/index.php)

Shaded relief from CentralFingerLakes 2020 1m LiDAR data set (http://gis.ny.gov/elevation/index.cfm)

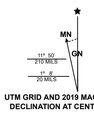
Magnetic declination from the NOAA online Declination Calculator: http://www.ngdc.noaa.gov/geomag-web/#declination

SCALE 1:24,000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 500 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL: 10 FEET

Geologic mapping by K. Backhaus, A. Kozlowski and A. Alrubay, 2023
Digital data and cartography, K. Backhaus, 2021-23



UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

INTRODUCTION:

The Mecklenburg 7.5-Minute Quadrangle was mapped as part of the National Cooperative Geologic Mapping Program's STATEMAP projects in 2020 and 2022, supported by awards #G20AC00418 and #G22AC00366. This quadrangle is one of twelve that have been mapped under the Tompkins County Surficial Geologic Mapping Project, which the NYSGS initiated in 2018 and aims to conclude in the mid-2020s. The purpose of this map is to identify and delineate various surficial and geologic materials with the intent to inform and guide municipalities in land-use, environmental, and natural resource decisions across its approximately 55-square-mile area.

The quadrangle is located along the central-western border of Tompkins County and the eastern-central boundary of Schuyler County in the Finger Lakes Region of New York State, approximately 6 miles west of the City of Ithaca. It encompasses the Town of Enfield, Town of Mecklenburg, and the Village of Cayutaville as the main municipalities. This part of Tompkins County is predominantly rural, characterized by large tracts of state-owned forest and private rural farmland. The Connecticut Hill Wildlife Management Area is located in the south-central portion of the quadrangle. The quadrangle is situated within the Alleghany Plateau physiographic province and features higher elevation ridges that generally ramp up to the south and west of the Town of Enfield, interspersed with deep, broad valleys. The elevation varies significantly, with a change of approximately 1,115 feet (340 meters) from the highest peak, Connecticut Hill, at 2,094 feet above mean sea level (638 meters-amsl) to the Taughannock Valley floor at 980 feet-amsl (299 meters-amsl). Cayuta Lake, Taughannock Creek, Cayuta Inlet and the Fivemile Creek are the major water bodies in the area.

Bedrock in the area is predominantly consists of grey to blue shales and sandstones, which are Devonian in age (Rickard and Fisher, 1970). Limestone outcroppings, though present in two spots, are relatively thin. The bedrock composition of the quadrangle, as detailed in the Finger Lakes sheet of the Geologic Map of New York State, consists of the Cashaqua and Middlesex Shales, Beers Hill Shale, Grimes Siltstone, Dun Hill, Millport and Moreland Shale, Geneseo Shale, the Ithaca Formation, and the Sherburne Siltstone (Rickard and Fisher, 1970).

The surficial geologic units within this quadrangle have previously been mapped at a scale of 1:250,000. This mapping identified a variety of units including swamp deposits, outwash gravels, kame moraine, kame, till, thin till over rock, as well as lacustrine silt and clays (Muller and Cadwell, 1986). Since then, there has been limited mapping conducted at a higher resolution than that achieved by Muller and Cadwell in 1986.

METHODOLOGY:

To create the surficial geology map of the Mecklenburg quadrangle, preliminary field maps were generated using ESRI ArcMap 10.8 software, incorporating all available topographic data, such as roads, LiDAR surface terrain, and hydrography. These maps served as the basis for plotting field data, including locations of field stops, bedrock outcrops, and other significant site information. For surficial soil sampling, a five-and-a-half-foot hand auger was employed, enabling sampling beneath the variably thick organic soil horizon (below the topsoil). Additionally, an entrenching shovel and pick were utilized for removing topsoil or eroded sediments from outcrops or exposures, revealing fresh sediments for analysis. At each field stop, various data were recorded in a field notebook. This included the coordinates (latitude and longitude in decimal degrees) obtained using a Garmin GPS 66st, the time of each stop, detailed notes describing the sediment, and information about whether a sample was collected or a high-resolution, scaled photo was captured.

At most field sampling sites, soil samples were collected for grain-size analysis, employing one of two methods: dry-sieve or wet-sieve analysis. These methods adhered to the procedure outlined by Bowles (1978), utilizing a seven-tiered sieve stack (#5, #10, #18, #35, #60, #120, #230, and Pan) for both the mechanical (dry-sieve) and hydrometer (wet-sieve) analyses. The choice between these methods was based on the sample's composition: predominantly cohesive (fine-grain dominant) samples were processed using wet-sieve analysis, while cohesionless (coarse-grain dominant) samples were analyzed using the dry-sieve method.

The final surficial geologic map, along with cross-sections and elevation map, were produced using ESRI ArcMap and Adobe Illustrator CS6. The cross-sections were initially created in ArcMap utilizing the XActo Cross-section 10 tool. These cross-sections were then exported to Adobe Illustrator for refinement and to connect the stratigraphic units. The surficial geologic map was created by scanning the mylar sheet, which was drafted from the geologic field map. This scanned map was digitized in ArcMap, where polygon shapefiles representing various surficial geologic units within the quadrangle were created and color-coded. The final drafting of the map was done in Adobe Illustrator and exported as a PDF file.

RESULTS:

A total of 361 field stops were conducted within the quadrangle, resulting in 130 samples collected for grain-size analysis (see Appendix). At some stops, multiple samples were collected due to the presence of stratigraphic variations, either in exposures or at depth as revealed by the hand auger. The final count of lithologies identified during field sampling included 238 stops with diamicton, 61 with bedrock, 46 with sand and gravel, seven with sand, six with glaciolacustrine sediment, two with alluvium, and one with cemented sand and gravel. The surficial geologic units found within the quadrangle are as follows:

Artificial Fill (Af)
This unit is generally composed of coarse to fine, large cement mounds and/or crushed rock, anthropogenically transported and used for construction purposes. It is utilized in the construction of artificial dams for water retention and in raised roadbeds for bridges within the quadrangle.

Holocene Alluvium (Ha) and Holocene Wetland Deposits (Hw)
Post-glacial sediments are found occupying low areas or land depressions throughout the quadrangle. The 'Hs' unit is associated with fluvial processes in creek valleys across the quadrangle, generally comprising stratified silt, sand, and gravel. In contrast, the 'Hw' unit is associated with low areas and depressions in the highlands of the quadrangle, where wetlands develop due to restricted drainage. This lithology is characterized by peat, marl, clay, or sand, reflecting these areas of poor drainage conditions.

Pleistocene Silt and Clay (Plsc)
Plsc comprises stratified, fine-grained sediment—fine sand, silt, and clay. It's inferred to be deposited in mid-shore to deep-water glacial lake settings, often including marl, rhythmites, and varves. This unit is mainly found at lower elevations near Enfield Creek's westernmost tributary along Trumbulls Corner Road and along Taughannock Creek Valley near State Route 228.

Pleistocene Sand (Ps)
Ps consists of well-sorted, stratified sand deposited through fluvial, lacustrine, or eolian processes, often linked to distal glacial environments. These well-sorted sands, observed down-slope from coarser sand and gravel deposits (Psg), indicate decreased depositional energy. Ps deposits are found in tributary creeks and within the Enfield Creek Valley near the quadrangle's eastern boundary, with smaller deposits along the Taughannock Creek valleys on the western boundary.

Pleistocene Sand and Gravel (Psg)
Psg, characterized by well-sorted, stratified sand and gravel, is interpreted as glacial meltwater deposits at or near the glacier. Found several meters above current river valley floors, it's located west of Enfield Creek, particularly in the higher elevations near Connecticut Hill and along the banks of Taughannock and Enfield Creeks.

Pleistocene Cobbles to Sand (Pics)
Pics consists of stratified, ice-contacted deposits with variable coarse-grained sediment, from boulders to sand particles. Inferred to be deposited at a stagnant ice margin in the form of sand and gravel hummocks, from melted ice blocks, with the northeast and northern section of the quadrangle as kame moraine deposits from meltwater emanating proximal to the ice margin. Pics is found in the Enfield Creek Valley, particularly at the Trumbulls Corner Kame Moraine, and along the flanks of Connecticut Hill traversing Griffin Road.

Cemented Sand and Gravel (Pcsg)
This unit is poorly sorted and matrix-supported in most locations, with the matrix comprising well-sorted sand cemented by calcite or silicate rinds around clasts. The clasts are predominantly from local Paleozoic bedrock but also including exotic granite and gneiss lithologies. Clasts vary widely in size from pebble gravel to cobbles. Pcsg are inferred to be subaqueous or proglacial outwash deposits. This unit is found along an ice-marginal position, cemented by mineralization from meltwater through existing sand and gravel deposits.

Pleistocene Diamicton (Pd)
This unit is a mixture of sediment grains that range from clay to boulders in size. In this quadrangle, all diamicton is interpreted to be deposited by glacial action, therefore is it referenced as glacial till. It is generally matrix supported, sand-dominant, and tan and reddish brown in color. Diamicton is found throughout the quadrangle independent of elevation and underlies most of the other surficial geologic units within the quadrangle.

Pleistocene Diamicton (Clast-Supported) (Pdcs)
The unit is an admixture of unsorted sediment from clay to boulders, typically clast supported, massive, and rich in clasts, and is interpreted as till. Within this quadrangle, identified moraines consist of clast supported till, with some being gravel-rich and exhibiting hummocky topography along morainal boundaries. Pdcs is predominantly found at elevations higher than Enfield and Taughannock Creeks, with the largest deposit located in the quadrangle's central portion.

SUMMARY AND CONCLUSIONS:

The Mecklenburg quadrangle, located along the western boundary of Schuyler and Tompkins Counties, features its highest point at Connecticut Hill in the south-central area. Bedrock (Br) is overlain, in most areas, by Pleistocene age sediments aside from hilltops and within stream-cut chasms. Bedrock within the mapping area is of Devonian age, primarily comprising black-to-grey shales, with interbedded sandstones and limestones. Bedrock outcrops in deep chasms, on hilltops, and sporadically in stream beds, particularly within the Enfield Creek tributary along Trumbull Corners Road, and in newly cleared ditches. The bedrock in the Mecklenburg quadrangle is overlain by sand-dominant, matrix-supported diamicton (Pd), interpreted as lodgement glacial till deposited at the base of the Ontario Lobe of the Laurentide Ice Sheet. Its classification as a lodgement till is based on the bimodal distribution of grains and high density. The clasts in the till, ranging from fine gravel to boulders in size, are an intermix of faceted to rounded exotic tillstones and local bedrock, embedded in a sandy clay matrix. A key distinction in these glacial tills is the grain-size distribution and matrix characteristics. Notably, former ice-marginal positions feature a distinct clast-supported matrix, often with an armored surface of mostly fine to coarse gravel and boulder sized clasts (Pdcs). Samples MBG-21-07 from the Perry City Moraine and MBG-23-54 & -55 from the Mecklenburg Moraine, both identified as Pdcs, or clast-supported diamicton, highlight these former ice-marginal positions and represent ablation till emanating off the glacial lobe.

The glacial till in the Mecklenburg quadrangle is overlain by predominantly coarse-grained deposits in the lowlands, consisting of medium sand to coarse gravel (Psg). These Psg deposits are massive, unbedded, and contain mostly subrounded to rounded clasts of exotic and local bedrock. The low-lying tributary valleys are primarily lined with Psg, interspersed with sporadic ice-contact deposits ranging from meltwater derived sand to cobble (Pics) and clast-supported glacial till (Pdcs). The distribution of Psg and/or adjacent to glacial till suggests their formation as outwash sediments from meltwater of the retreating Ontario Lobe, flowing south through Taughannock Creek, Enfield Creek, and the West Branch of the Cayuta Inlet.

SUMMARY AND CONCLUSIONS: Continued...

At the lowest elevations along these creeks, silty fine to medium sand deposits (Ps) were identified adjacent to or just above the modern floodplain. At stop MBG-23-120, located along State Route 228 above Taughannock Creek near the western edge of the mapping area, stratified sand, and gravel with massive beds of fine to medium sand were observed. An Optically Stimulated Luminescence (OSL) sample was collected at this site and may aid in constraining the timing of the ice retreat in the former Glacial Lake Cayutaville basin. The deposits at this location are interpreted to be the final remnants from the retreating Ontario Lobe. Additional evidence supporting this interpretation was found throughout the valley traversed by State Route 228, where more sand, sandy gravel, and glaciolacustrine deposits were discovered atop glacial till, bounded by a significant moraine to the south-west. In the quadrangle's extreme northwest corner, a small deposit of cemented sand and gravel (Pcsg) was located adjacent to a past ice-marginal position in the Finger Lakes National Forest. These Pcsg deposits, formed from ice-contact meltwater, are similar to those found in adjacent quadrangles.

While the topography gradually rises in elevation towards the south-central portion of the Mecklenburg quadrangle, the surface is predominantly flat-lying and dissected by modern stream channels. The region features six principal east-west ice marginal landforms: the Mecklenburg, Beck Road, Perry City, Aiken, Black Oak, and Cayutaville Moraines, ordered from north to south. These moraines are comprised of clast-supported diamicton (Pdcs), deposited over previously deposited glacial till (Pd), while the Enfield Moraine is distinctly classified as a kame moraine comprised of ice-contact sand and cobbles. Streamlined landforms are only present between the Aiken and Black Oak moraines, suggesting a possible surge event during one of the Ontario Lobe's southward advances. Towards the southern mapping area, the terrane becomes mountainous and is draped with hummocky topography featuring ice-contact cobbles and sand, clast-supported diamicton, and medium sand and gravel. Within the deposits just north of Cayutaville Road lies a lone, kame deposit, characterized by bedded medium sand interspersed with subrounded gravel clasts.

Upon completion of field mapping within this portion of the Mecklenburg quadrangle, the geomorphic features and distribution of deposits suggests that the expansive glacial till and defined ice margins are likely due to the retreat of the Ontario Lobe to the north. Evidence for a previously undefined glacial lake, named by the authors as Glacial Lake Cayutaville, was discovered in the southwest quadrant. This former glacial lake basin partially overlaps with the current Cayuta Lake basin and is surrounded by extensive swamp deposits. The small patch of isolated drumlins in the central mapping area may suggest a minor readvance from the Aiken Moraine to the Black Oak Moraine, however, more evidence is necessary to accurately determine the overall timing of the advance and recession of the ice sheet in this area.

REFERENCES:

Bowles, J.E., 1978, Engineering Properties of Soils and Their Measurement (second edition): McGraw-Hill Book Company, NY, 213 p.

Muller, E.H., and Cadwell, D.H., 1986, Surficial geologic map of New York: Finger Lakes sheet: New York State Museum Map and Chart Series 40, scale 1:250,000, 5 sheets.

Rickard, L.V., and Fisher, D.W., 1970, Geologic map of New York: Finger Lakes sheet: New York State Museum Map and Chart Series, No. 15, scale 1:250,000, 5 sheets.

DESCRIPTION OF MAP UNITS

Holocene

Af — **Artificial Fill (Af)**
This unit is generally composed consists of coarse/-to-fine, materials such as large cement mounds and/or crushed rock , which have been transported anthropogenically transported and used for construction purposes.

Ha — **Stratified silt, sand and gravel (Ha)**
Sorted and stratified silt, sand, and gravel, deposited by rivers and streams. May include cobbles and boulders. Inferred as post-glacial alluvium and includes modern channel, over-bank and fan deposits.

Hdc — **Diamict Colluvium (Hdc)**
Unsorted and unstratified deposit of gravel, sand, silt, clay, with boulders/cobbles possible. Described as a mass-wasting deposit at the base of steep hillslopes and cliffs as part of a slump or hillslope failure.

Hw — **Wetland Deposit (Hw)**
Peat, muck, marl, silt, clay or sand deposited in association with wetland environments. Various sediments can be present at transitional boundaries from one facies to another.

Pleistocene

Plsc — **Silt and Clay (Plsc)**
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Inferred to be deposited in mid-shore to deepwater settings of glacial lakes. May include marl, rythmites, and varves.

Pics-iw — **Ice Contact Silt and Clay (Pics-iw)**
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Constrained to isolated pockets, inferred to be deposited in circular depressions within or on former ice sheets.

Ps — **Stratified Sand (Ps)**
Well-sorted and stratified sand, deposited by fluvial, lacustrine or eolian processes. Inferred as deposits associated with distal glacial environments.

Psg — **Stratified sand and gravel (Psg)**
Well-sorted and stratified sand and gravel. May include cobbles and boulders. Inferred to be delta, fan or lag deposits in glacial channels or near former ice margins.

Pcsg — **Cemented Sand and Gravel (Pcsg)**
Poorly sorted and matrix supported in most locations. Matrix consists of well-sorted sands cemented with well developed calcite or silicate rinds around clasts. Clasts are predominately from local Paleozoic bedrock but include exotic lithologies of granite and gneiss and range in size widely from pebble gravel to cobbles. Inferred to be subaqueous or proglacial outwash deposits.

Pics — **Cobbles to Sand (Pics)**
Stratified, ice contact deposits, variable coarse-grained sediment consisting of boulders to sand size particles. Inferred to be deposited along an ice margin. May include, interbedded coarse lenses of gravel and clast-supported diamicton (flow till).

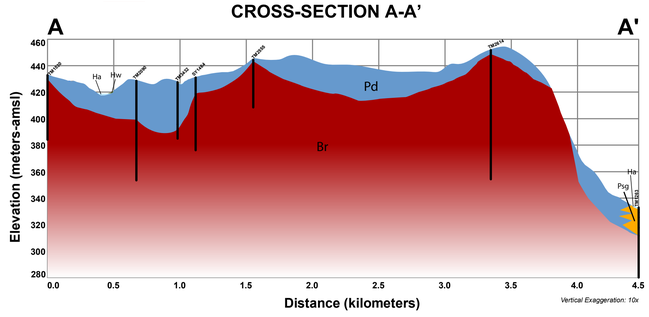
Pd — **Diamicton (Pd)**
An admixture of unsorted sediment ranging from clay to boulders. Generally matrix-supported, massive and clast-rich.

Pdcs — **Diamicton (Pdcs)**
An admixture of unsorted sediment ranging from clay to boulders. Generally clast-supported, massive and clast-rich.

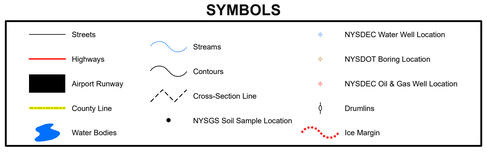
Pre-Pleistocene

Br — **Bedrock (Br)**
Non-glacially derived, hard rock, pre-pleistocene in age. May be covered up to a meter in diamicton, sand and gravel, or sand and clay in areas marked as Br.

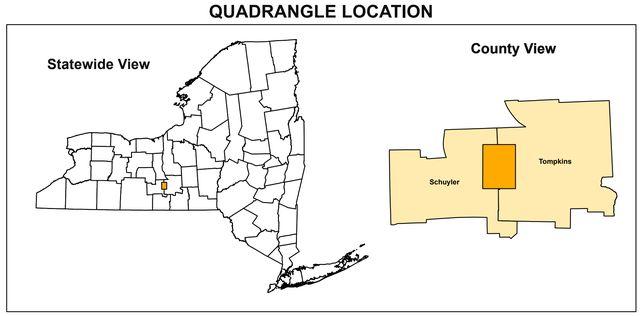
CROSS-SECTION A-A'



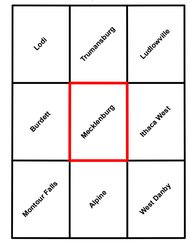
SYMBOLS



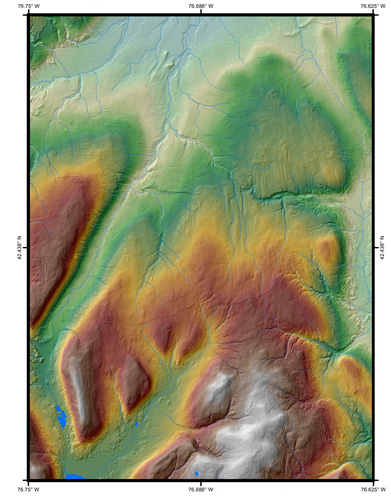
QUADRANGLE LOCATION



ADJOINING QUADRANGLES



QUADRANGLE ELEVATION



1:75,000 scale; 2x vertical exaggeration

Feet-amsl
985 2100

Shaded relief generated from 2020 Central Finger Lakes 1-meter Lidar data set by the New York State Group Purchasing Organization.

SURFICIAL GEOLOGY OF THE TOMPKINS COUNTY PORTION OF THE MECKLENBURG 7.5-MINUTE QUADRANGLE, NEW YORK

Karl J. Backhaus and Andrew L. Kozlowski
2021

NOTICE

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