New York State Museum
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New York Geological Survey
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# DRIFT THICKNESS OF CAYUGA COUNTY, NEW YORK

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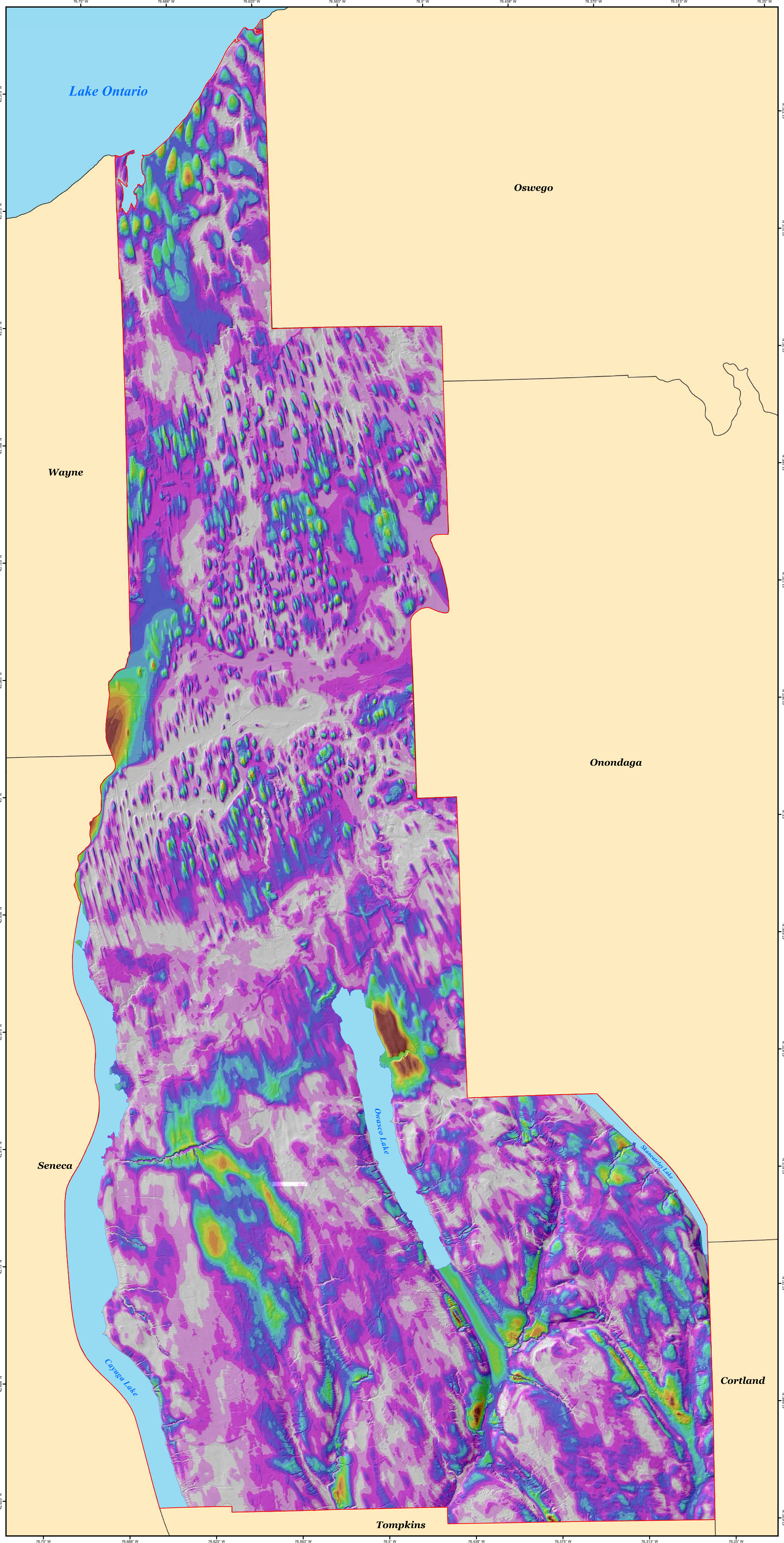
2019




Digital data and cartography, K. Backhaus and B. Bird, 2016-22.

Digital Data and Cartography by K. Backhaus and B. Bird, 2016-2019.

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

Geographic and hydrograpghy data obtained from the NYSGIS Clearinghouse (https://gis.ny.gov/)

Shaded relief from Cayuga and Oswego Counties 1-meter Lidar data sets by NYSGPO (http://gis.ny.gov/elevation/index.cfm)

SCALE1:100,000

Kilometers: 0, 2.5, 5, 10, 15, 20
Meters: 0, 10,000, 20,000
Miles: 0, 1.25, 2.5, 5, 7.5, 10
Feet: 0, 6,250, 12,500, 25,000, 37,500, 50,000

## Introduction

Throughout the nine years of geologic mapping in Cayuga County (2010-2019), the end goal was to create a three-dimensional map of the geology of the county. Three-dimensional maps consist of up four maps: Surficial Geology (underlain by elevation data), Bedrock Geology, Bedrock Topography and Drift Thickness. Prior to beginning the geologic mapping of Cayuga County, the geology was relatively unknown aside from the 1:250,000 scale Bedrock and Surficial Geologic maps of New York State (Rickard and Fisher, 1970; Muller and Cadwell, 1986). The geologic mapping that occurred in Cayuga County from 2009-2018 was focused on its surficial geology. This involved determining the extent and character of the surficial geology, or drift within the county. Drift is unconsolidated sediment that was either directly deposited by glacial, fluvial or aeolian processes.

Upon completion of the geologic mapping in 2018, fourteen quadrangles (Map and Chart Series #: 60, 65, 76, 77, 82-86, 88-90, 96-97, and 107), one interpretive publication (Map and Chart Series #105) and the Surficial Geologic Map of Cayuga County (Map and Chart Series #104) were made and published by the New York State Museum/Geological Survey. Work simultaneously began on delineating the bedrock surface to determine the topography of the Paleozoic bedrock in the county and ultimately determine the drift thickness of county. Knowing the bedrock topography of the county is useful when searching for freshwater aquifer systems, understanding the subsurface movement of contaminants and groundwater. It also provides an important context for understanding the natural history of the county and where possible aggregate resources might be located.

## Methods

To create the drift thickness map of the county, a total of 1,725 bedrock control points were compiled to delineate the bedrock topographic surface. These points consist of 1186 water wells, 262 oil and gas wells, 57 engineering boreholes, 18 exploratory boreholes, 93 sampling stops, and 109 known bedrock outcrops. From these points, using their latitude and longitude, the surface elevation was extracted from the 2018 Cayuga/Oswego 1-meter lidar DEM and the depth to bedrock was subtracted. This elevation is the true bedrock surface elevation. These data were entered ESRI's ArcMap 10.6 program and using the "Contours" tool, 50ft contours were generated (see inset map to the bottom right). Using the bedrock surface elevation from each point and knowing the surface elevation in the county, the contours were adjusted manually through a multi-review process to fix any errors created by the tool. The contours, after being adjusted, were then converted into a 10-meter raster using the "Topo to Raster" tool and excluded the Finger Lakes within the county as bedrock depth is unknown, or poorly constrained within the lakes themselves. The raster generated from the contours is then resized to a 1-meter resolution using the "Resampling" tool. This map construction technique is performed to heighten the resolution of the raster and match that of the DEM that it is subtracted from. Lastly, the "Raster Calculator " tool is used to subtract the surface elevation from the bedrock elevation to determine the thickness of the drift in the county.

## Discussion

Upon completion of the Drift Thickness of Cayuga County map, the drift thickness was found to range from zero to over 360 feet. The thinnest drift is found where bedrock outcrops at the surface occur and generally north of the City of Auburn within the county. The thickest drift lies within the basins of Cayuga, Owasco and Skaneateles Lakes, and a few other areas. The finger lake basins are analogous to fjords found in Sweden and Norway and as such these narrow, deep valleys have been infilled with sediments either deposited or eroded by glacial and fluvial processes and freshwater since their formation. The actual depth to bedrock is relatively unknown due to the lack of bedrock control points as no water wells, exploratory borings or engineering borings have been completed directly in the basins to bedrock. The drift thickness in the Owasco Inlet has been estimated to be just deeper than the water wells, and as deep as seismic studies of the area have suggested (Mullins, et. al., 1996).

One area of thick drift that is already known is the Great Gully Buried Valley system to the south and east of the Town of Union Springs (Kozlowski, et. al., 2016; Kozlowski, et. al., 2018). This NNW-SSE trending valley extends through the Great Gully to the Little Salmon Creek valley. With the completion of the map, another fork of the Great Gully Buried Valley system became apparent that has a more northward trend and aligns with the Big Salmon Creek valley in Genoa. The confluence of the Big and Little Salmon Creeks also contain a thick accumulation of drift made up of Pleistocene Age (2.58 million to 12 thousand years before present) sand and gravel deposits (Kozlowski, Leone and Bird, 2015). These deposits were likely glacial outwash or kame deposits from the last major ice advance into this area. Another thick area of drift is along the Mapleton Moraine, which is a terminal ice margin constructed by sediment deposits off the edge of the glacier during the Port Huron Readvance (Kozlowski, et. al., 2018; Kozlowski, et. al., 2016; Leone and Kozlowski, 2015; and Bird and Kozlowski, 2015). At the north end of Owasco Lake is an anomalously thick area of glacial drift along the eastern shore. This section is currently under investigation by the New York State Geological Survey as many water well logs in this region show stratified (layered) sediment. This location may represent an additional buried valley segment.

Within the town of Moravia there is a large sand and gravel deposit that similar in origin to that of the one found at the confluence of the Big and Little Salmon Creek. Bedrock does outcrop in town along Mill Creek and these deposits have been down cut by the creek since their deposition. To the east of the Town of Moravia, each valley seems to reflect a similar trend with thick sediment deposits either in the center of the basins or along valley walls where there is a low amount of control points to accurately delineate the bedrock surface.

## Error Analysis

The most problematic error during the creation of the map was caused by the rugged and irregular surface within the county. Common errors were caused by the lack of bedrock control points in many areas of the county, which made correlating the bedrock surface difficult. Key locations needing additional subsurface data include: the finger lake basins, the City of Auburn, state forest lands and areas north of the Montezuma Wetlands Complex. Other errors are associated with the lack of control points, in some areas the bedrock surface that protrudes above the true surface of the county. This error was corrected in most areas, but some regions do not have enough elevation control points. The valley walls of the lake basins largely had this issue as a lack of data density resulting from minimal well control, thus the uncertainty of the bedrock surface/drift thickness is higher in these regions. As most of the bedrock control points are water well records, some uncertainty must be considered. Inaccuracies in the depth to bedrock reported and if the wells "bedrock" is actual bedrock. The diamicton, also known as glacial till/hardpan or clay/gravel in well logs, is sometimes incorrectly logged/reported as bedrock and thus, the bedrock in the area is deeper than what is recorded.

## Conclusions

With the rugged and irregular terrain, the many glacial episodes and various bedrock lithologies within the county, the drift thickness varies greatly in either direction. The work completed by the New York State Museum/Geological Survey has created the first high-resolution drift thickness map for Cayuga County. The areas of thick drift within the county can now be investigated further to determine the character, hydrogeologic properties and age of these deposits.

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## Explanation

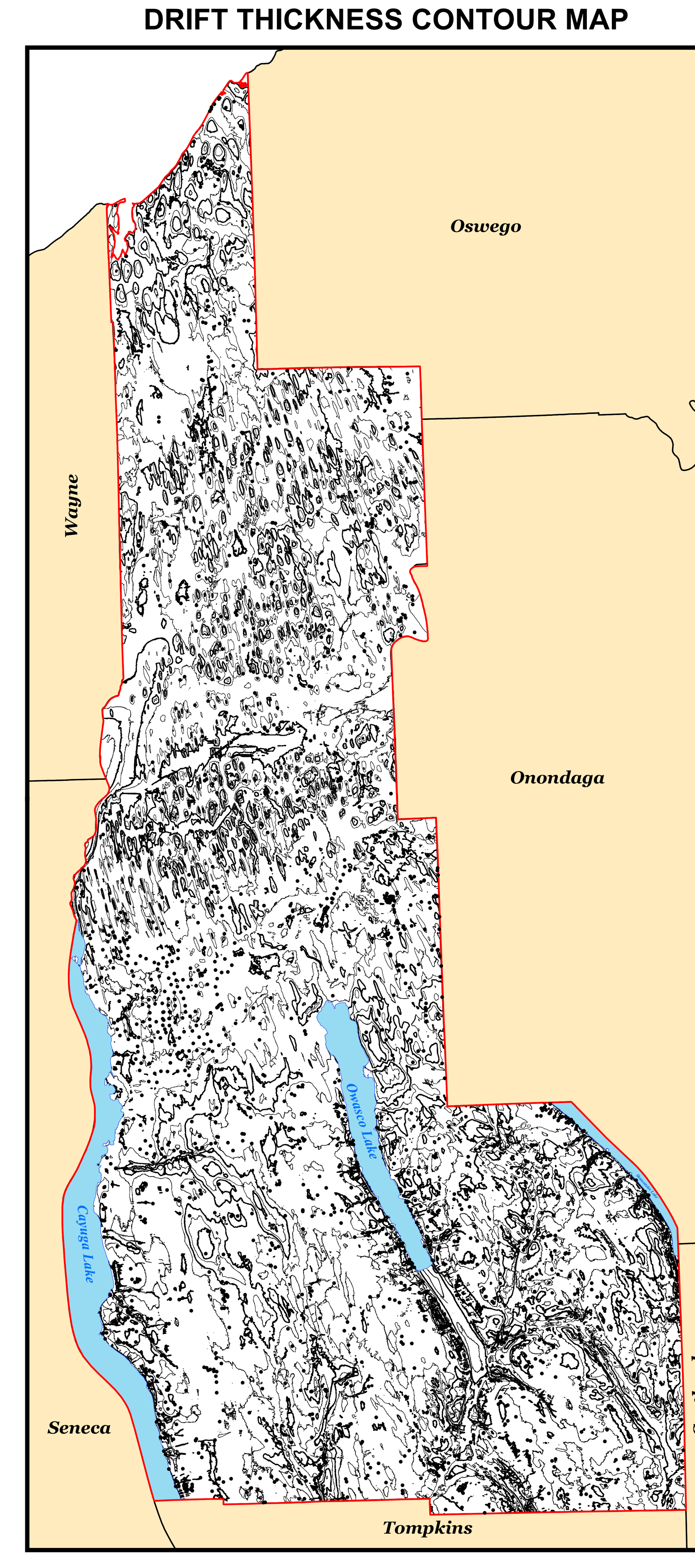
- Reference Points
- 50-foot Contour
- 100-ft Contour
- Cayuga County Line
- Surrounding Counties
- Water Bodies

### Drift Thickness

Feet Thick

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 360

## DRIFT THICKNESS CONTOUR MAP




**New York State Museum Map & Chart No. 126**
ISSN:0097-3793 ; ISBN:978-1-55557-282-2