

From Land to Water: Mapping Nutrient Risk Areas in the Skaneateles Lake Watershed

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6 CLEAN WATER AND SANITATION



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A Lake Under Pressure

- Almost every summer, green streaks creep along the shoreline of Skaneateles Lake, signaling the presence of **harmful algal blooms (HABs)**
- Also known as “toxic algae” or “blue-green algae”
- These blooms are visible patches of **cyanobacteria**
- Cyanobacteria are microscopic organisms that are naturally present in aquatic ecosystems
- However, when warm temperatures, little wind, and excessive nutrients are combined, these photosynthetic bacteria rapidly multiply and produce toxins
- Land areas with little vegetation allow rainwater to flow rapidly across the landscape
- Carrying nutrients from fertilizers and pesticides, particularly **nitrogen and phosphorus**
- Instead of being absorbed by the natural environment, these nutrients are transported directly into streams and eventually into the lake
- What areas within the Skaneateles Lake watershed are most vulnerable to nutrient runoff?**

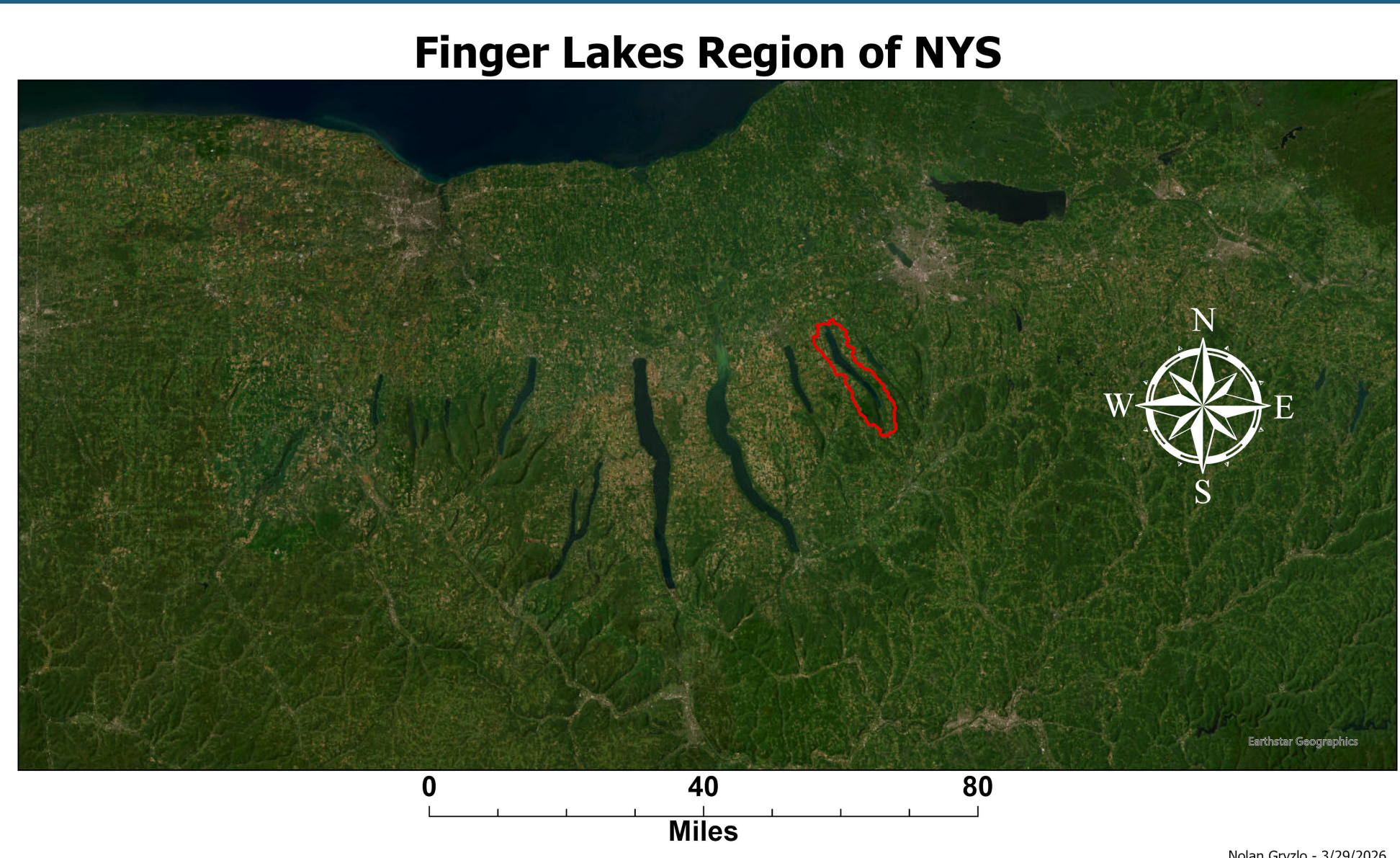


Figure 1: Study Area

What's at Stake?

- HABs pose a **health hazard** for recreation, aquatic ecosystems, and drinking water
- Contact via touch or consumption can lead to negative health effects in humans and animals
 - Symptoms include allergic reactions, nausea and vomiting; and skin, eye, and throat irritation
- If a HAB becomes dense enough, it can block out sunlight, harming aquatic plants below the surface
- Once a bloom decays, the process (hypoxia) uses up oxygen in the water, suffocating aquatic animals
- Skaneateles Lake supplies drinking water to **over 200,000** Central New York residents, with a majority in the City of Syracuse
- Skaneateles is also considered to be the most pristine Finger Lake

Mapping the Risk

- GIS (Geographic Information Systems)** is used to create a **weighted risk index**
- Geoprocessing tools utilized in ArcGIS Pro include Clip Raster, Slope, Feature to Raster, Reclassify, Euclidean Distance, Mosaic to New Raster, and Raster Calculator
- Land use, slope, and distance to water (environmental variables)**
- Land use was assigned the highest weight (**50%**) due to its dominant control on nutrient levels, acting either as sources or sinks
- Slope was included (**25%**) to represent the influence of topography on runoff velocity and soil erosion, which can enhance or diminish nutrient transport
- Distance to water was incorporated (**25%**) as a measure of connectivity, reflecting the possibility that runoff will reach streams and the lake

Tools Used – Land Use	Purpose
Reclassify	Assign runoff risk values to each land use type (0-100)
Tools Used – Slope	Purpose
Mosaic to New Raster	Stitching DEMs (digital elevation models) together
Slope	Convert combined DEM into a slope layer
Raster Calculator	Stretch values 0-100
Tools Used – Distance to Water	Purpose
Feature to Raster	Convert streams/lake polygon to raster layers
Raster Calculator	Combine streams/lake into one raster
Reclassify	Value of water = 1, everything else = 0
Euclidean Distance	Calculate distance from water
Raster Calculator	Stretch values 0-100

Generating Skaneateles Lake Watershed Nutrient Runoff Risk Index

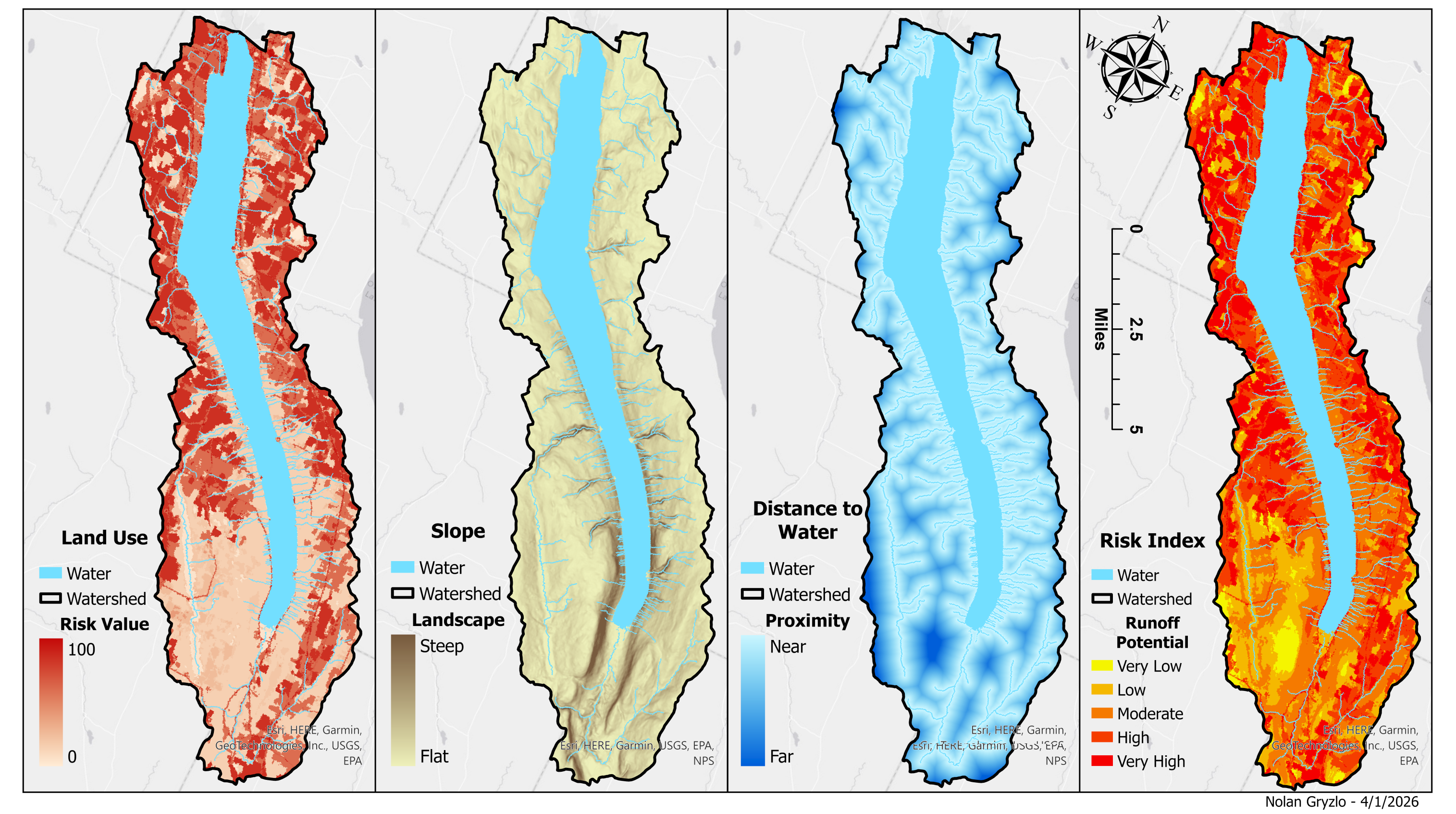


Figure 2: Four map frames are shown in this layout. The Land Use map illustrates the assigned risk values for the watershed. Dark red depicts higher risk and light red depicts lower risk. The Slope map highlights the differences in topography within the watershed, with steep areas shown in dark tan and flat areas shown in light tan. The Distance to Water map shows proximity to the lake and streams. These three maps are weighted and combined using Raster Calculator, to create the Risk Index map on the far right.

Key Findings

- The southwest area of the watershed shows **lower** risks of nutrient runoff (dominated by forests and wetlands)
- The northern end of the lake exhibits **higher** risks of nutrient runoff (contains more developed areas)
- Outlines of roads and farmland are visible as high risk, acting as major influencers of nutrient transportation
- Generally, as distance increases from the lake, risk levels decrease (**exceptions** are farmland and residential areas)
- Figure 3 depicts large swaths of farmland present throughout the watershed, along with wetlands/forests
- Overall, the Skaneateles Lake watershed appears to be **highly susceptible** to nutrient runoff based on the three environmental variables used

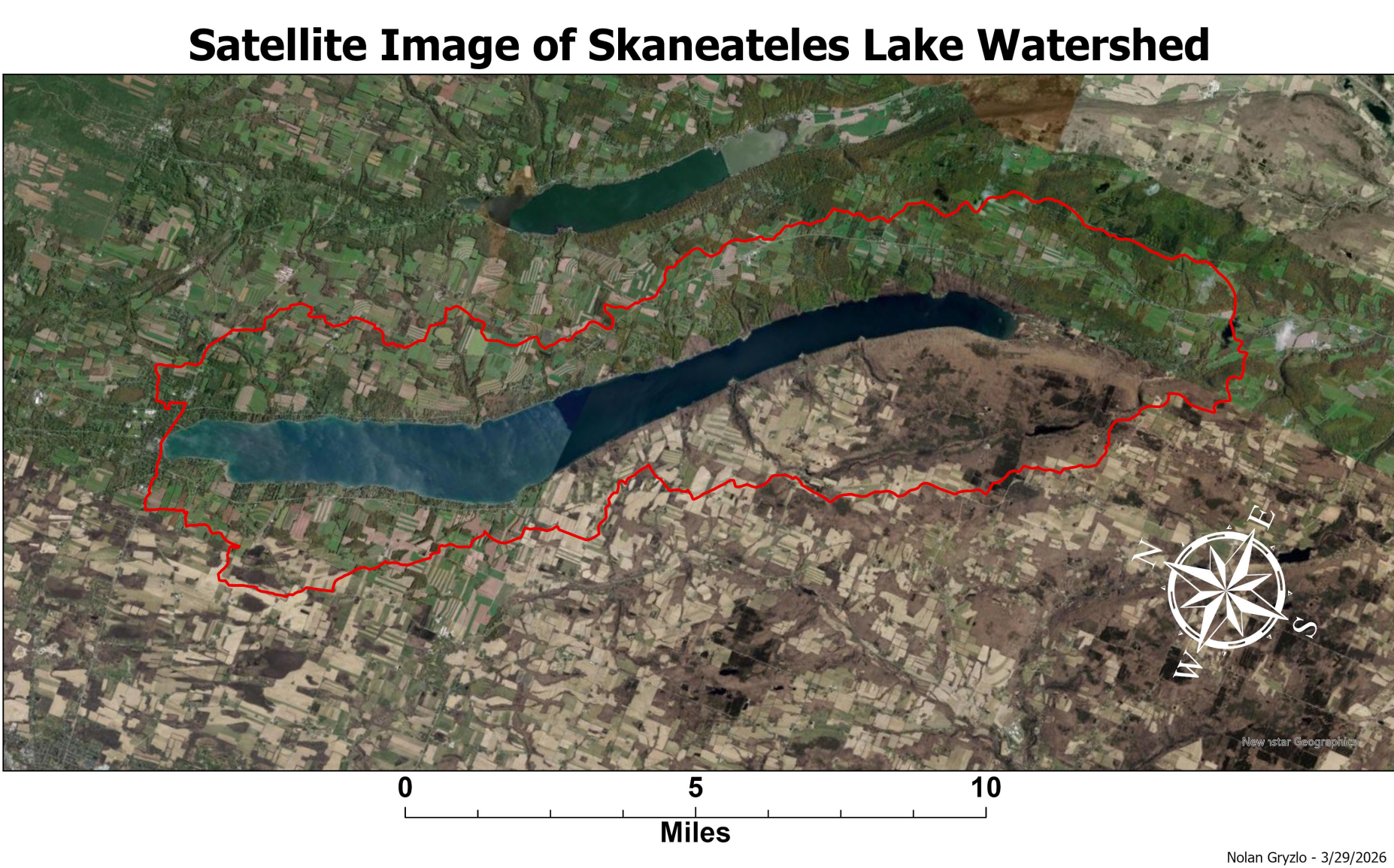


Figure 3: Satellite image of Skaneateles Lake watershed

Final Thoughts

- The multiple high-risk areas identified within the watershed of Skaneateles Lake explains the frequency of HABs during summer months
- Slope and distance to water are environmental features that cannot be easily modified, unlike land use
 - Offers the opportunity for **intervention**, such as increasing native plant buffers, responsible land development, and reducing nutrient inputs
 - It is important to be aware of how land use practices can influence water quality downstream
- HABs will continue to persist unless meaningful change in **land use management** are made

Acknowledgements

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References

Available upon request