

Depth vs. Development: Evaluating the Accuracy of 'At Capacity' Designations in Predicting Water Quality in Haliburton Lakes

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Introduction

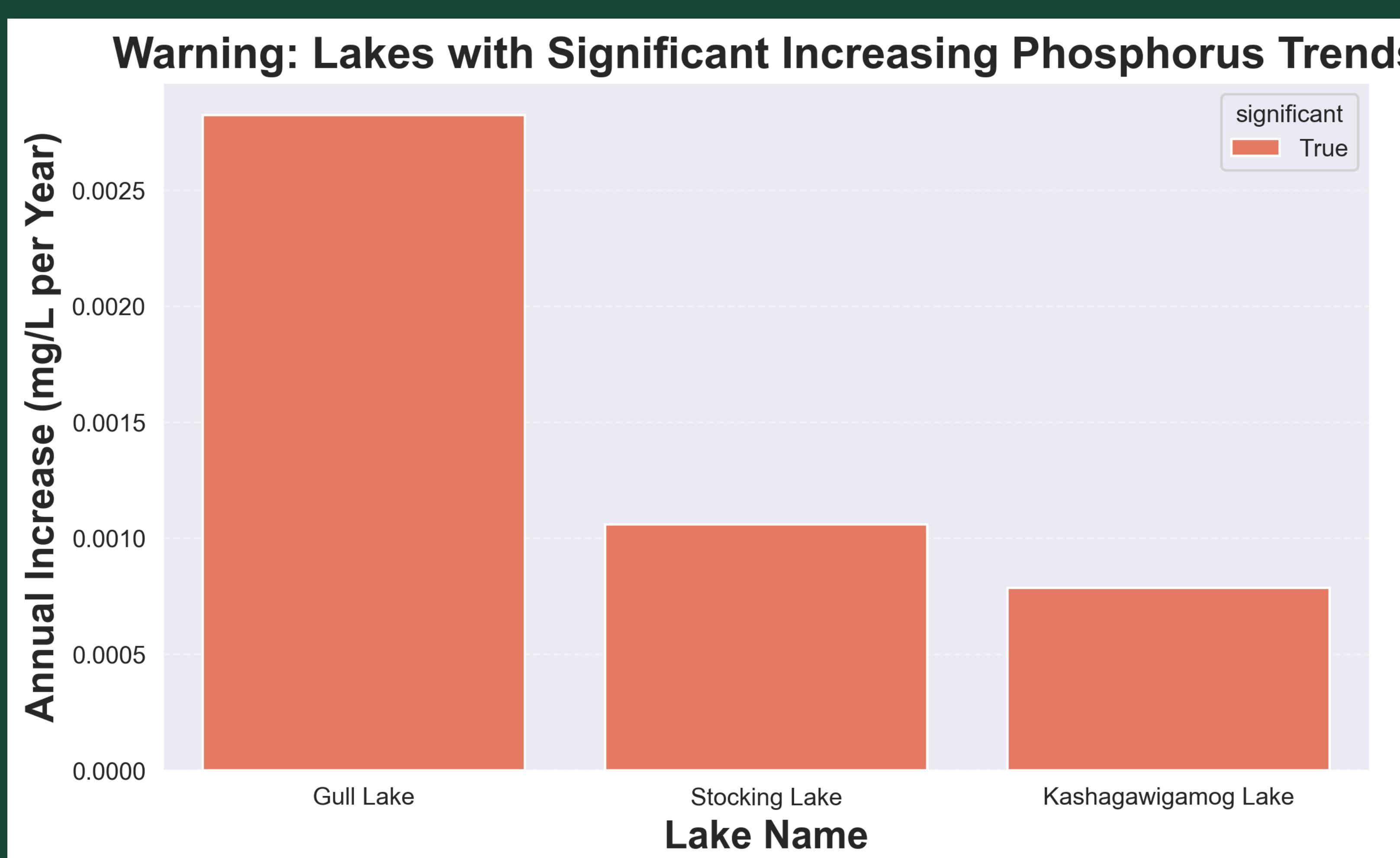
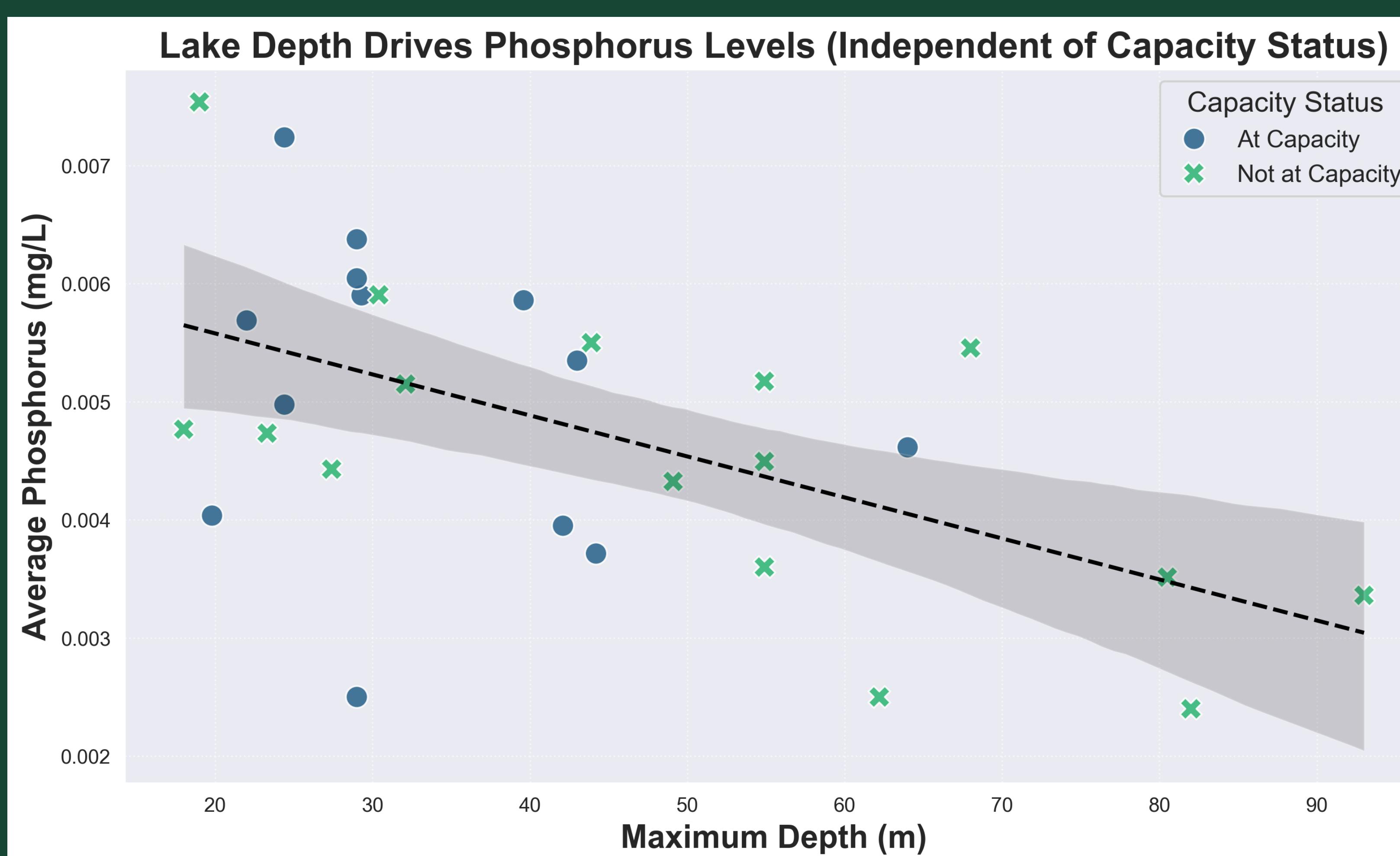
- Context:** Effective lake management distinguishes natural morphometric drivers (e.g., depth, shape) from anthropogenic impacts (e.g., development).
- Objective:** Evaluate if Haliburton's "At Capacity" designation matches observed water chemistry.
- Hypothesis:** Development intensity correlates with nutrient enrichment; deeper lakes show greater resilience.
- Goal:** Validate capacity classifications and identify lakes with concerning long-term trends.
- Research Questions:**
 - How does development and morphometry (area, depth, residence time, headwater/throughflow) relate to water quality status and trends?
 - What comparisons in physical/chemical parameter data can be made across lakes of similar features?

Method

- Data Pipeline:** Python ETL pipeline.
- Action:** Harmonized fragmented data; resolved naming issues (e.g., "Straggle Lake") via coordinates.
- Data Integration:** Merged morphometric/development data (CHA Reports) with water quality records for 38 lakes.
- Trend Analysis: Used seasonal OLS regression for annual phosphorus trends.
- ANCOVA:** Assessed capacity status impact on phosphorus, controlling for depth.
- MANOVA:** Compared chemical profiles (TP, pH, conductivity) across development categories.

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Lake depth is the primary driver of water quality in Haliburton, overriding development capacity status. However, emerging phosphorus trends in specific lakes like Gull and Stocking require targeted monitoring.



Results

- Key Driver:** Maximum depth was the strongest predictor of water quality, showing a significant negative correlation.
- Capacity Status:** ANCOVA revealed no significant difference in phosphorus between "At Capacity" and unconstrained lakes.
- Trends:** While most lakes remain stable, Gull, Stocking, and Kashagawigamog lakes showed significant phosphorus increases.
- Conclusion:** Localized enrichment risks exist, but they are not strictly tied to the current capacity designations. This suggests revising capacity models to prioritize depth and morphometry over development alone for better policy decisions.

