

# Flowing Through Time: The Dynamics of Water Systems

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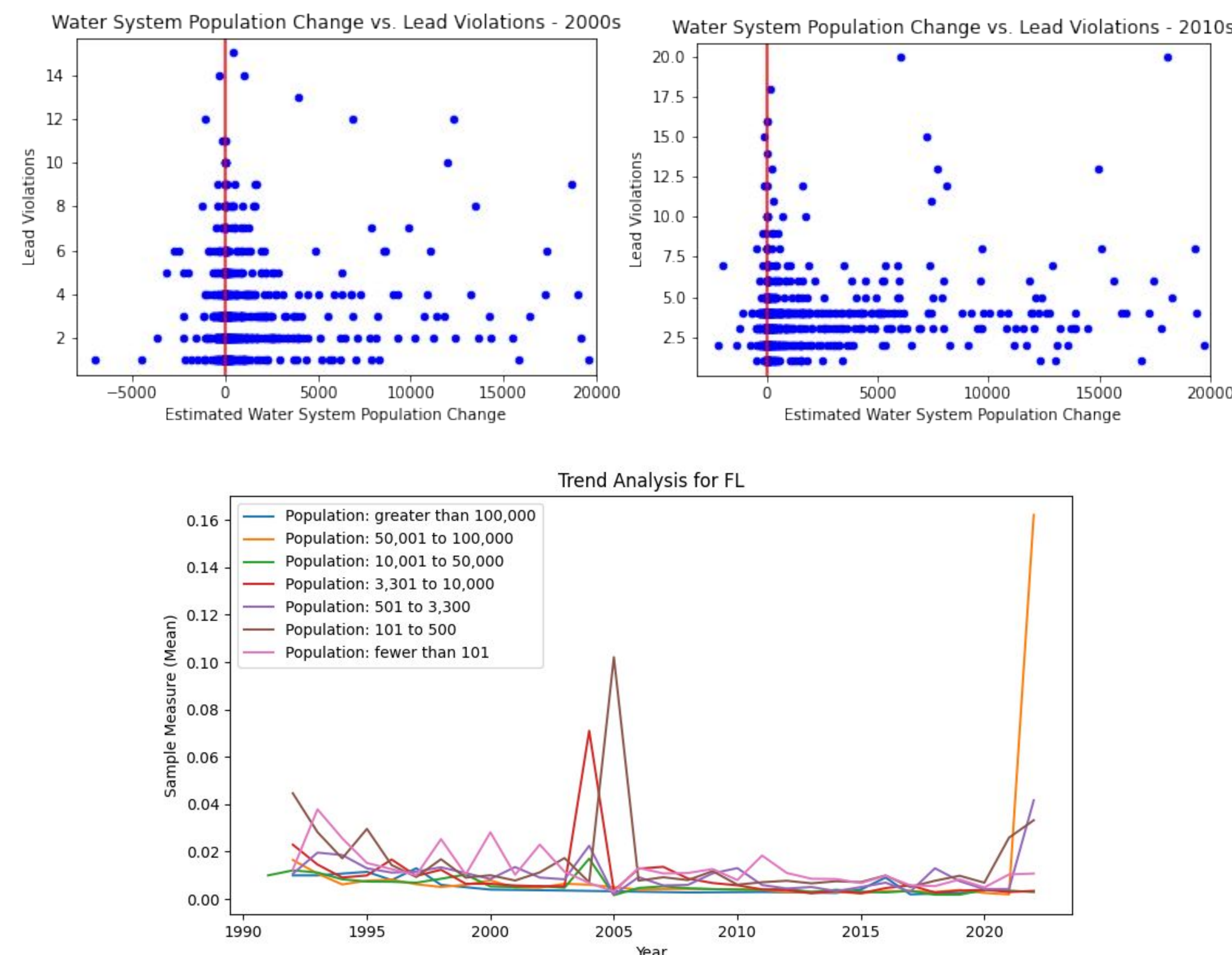


## Background

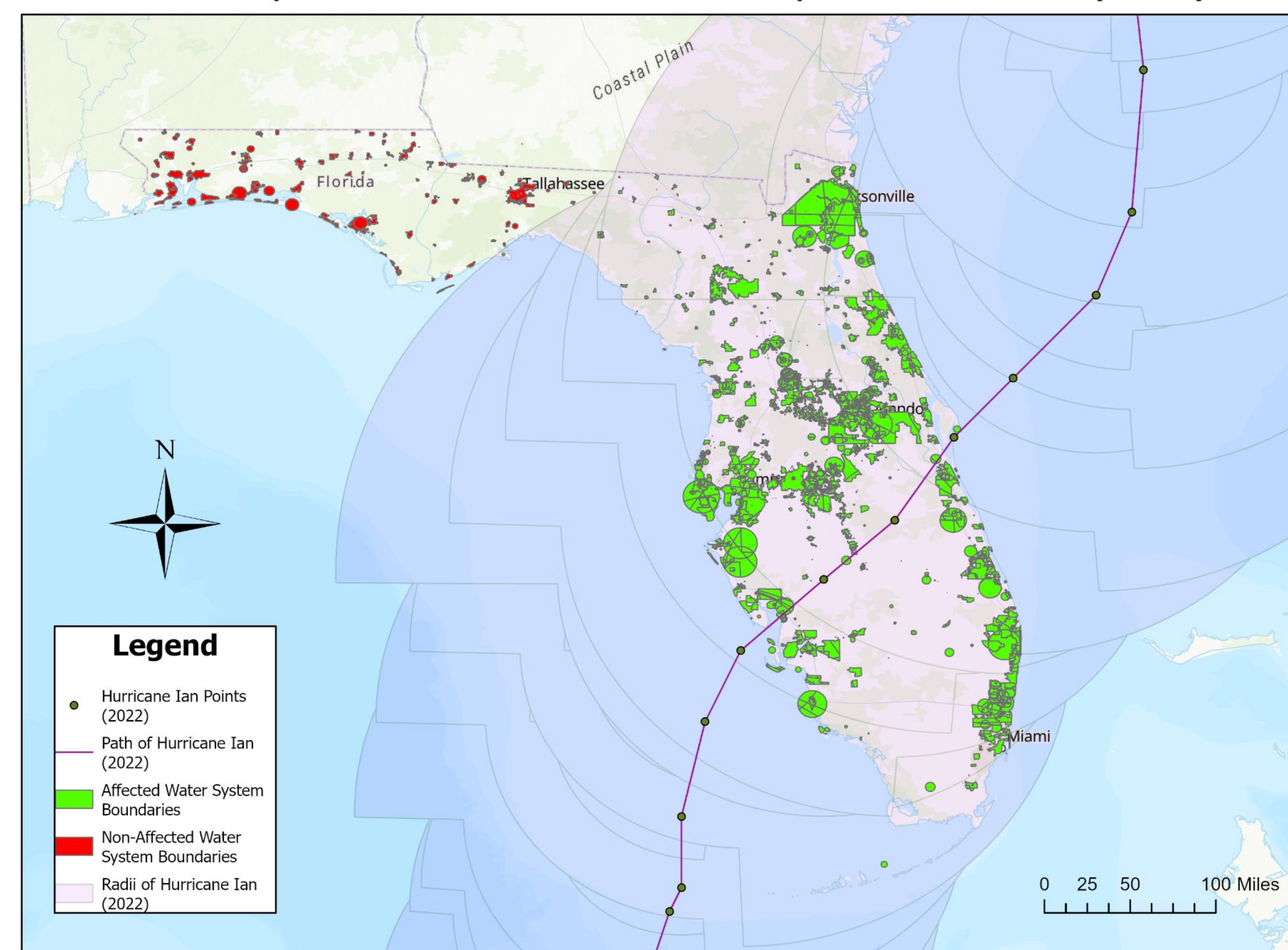
Water is a vital resource in any community. It is paramount to uphold the resource to strict guidelines to ensure the health of every citizen. The Environmental Protection Agency (EPA), tasked with the mission to protect human health and the environment, actively implements and enforces the Safe Drinking Water Act (SDWA) today, enacted under Congress in 1974, to regulate contaminants in water, oversee water testing & processing, and for funding of underdeveloped water systems. Additionally, the SDWA encompasses natural disasters as they play a role in the disruption and contamination of water systems, specifically, hurricanes which the National Oceanic and Atmospheric Administration (NOAA) closely monitors which indirectly supports the goals of the SDWA by providing critical weather information and forecasts in preparation and responding to hurricanes.

## Organization & Goals

For this study, we focused on the Lead and Copper Rule (LCR) and SDWA Violations Enforcement dataset to examine instances and sampling of lead, nitrates, and nitrites in public water systems in conjunction with the U.S. Decennial Census to connect population estimates to said water systems and identified if there is a correlation between population changes and large number of violations and inverse effects. Furthermore, utilizing the National Hurricane Center (NHC) Reports from NOAA, we examined any disruptions of water systems impacted by the hurricane's path, more specifically, the radii of the storm and corresponding water systems found inside. This analysis is crucial for identifying trends in water system violations, especially about population density. If no direct correlation is apparent, hurricane data can highlight whether infrastructure weaknesses or redevelopment issues contribute to increased violations. Such insights are valuable for policymakers and water system operators, guiding them in implementing effective measures to reduce these violations.



Water System Boundaries Affected by Hurricane Ian (2022)



## Observations

In Florida, a 2021 peak in lead concentrations was observed in populations of “50,001 to 100,000”, with minor peaks in smaller groups from 2004 to 2006. While smaller populations may show higher lead levels, the data does not firmly link population size to lead concentrations. Also, declines in populations with high lead violations do not conclusively indicate that lead causes significant population decreases due to various influencing factors.

As seen in the map, hurricanes can significantly impact water system boundaries. By mapping the affected areas, we identified which drinking water systems are most at risk before and after hurricanes, helping communities prepare and ensure access to clean water. In this visualization, only Hurricane Ian was mapped; however, we can further expand upon this by analyzing all past and present hurricanes to help identify a trend.

## Implications

While lead and nitrate are naturally occurring compounds, agricultural runoff is another major contributor to lead and nitrate violations, as agriculture is one of Florida’s largest assets, pulling in \$7.7 billion in agricultural cash receipts just in 2021. Specifically, fertilizer is the most detrimental runoff when examining Florida’s agriculture as it contributes to increased nitrate levels, leading to pollution and subsequent health problems when exposed to drinking water. Furthermore, nitrate contamination may increase lead solubility, commonly seen in older plumbing, leading to lead levels that cause further violations. Similar to the influence of agriculture on water systems, hurricanes are another external factor affecting these water systems. Exploring the precise connection between hazards like flooding and storm surges caused by hurricanes and the previously mentioned concerns of water contamination could provide valuable insights. Additionally, understanding potential mitigation strategies for these issues in the future would be intriguing.