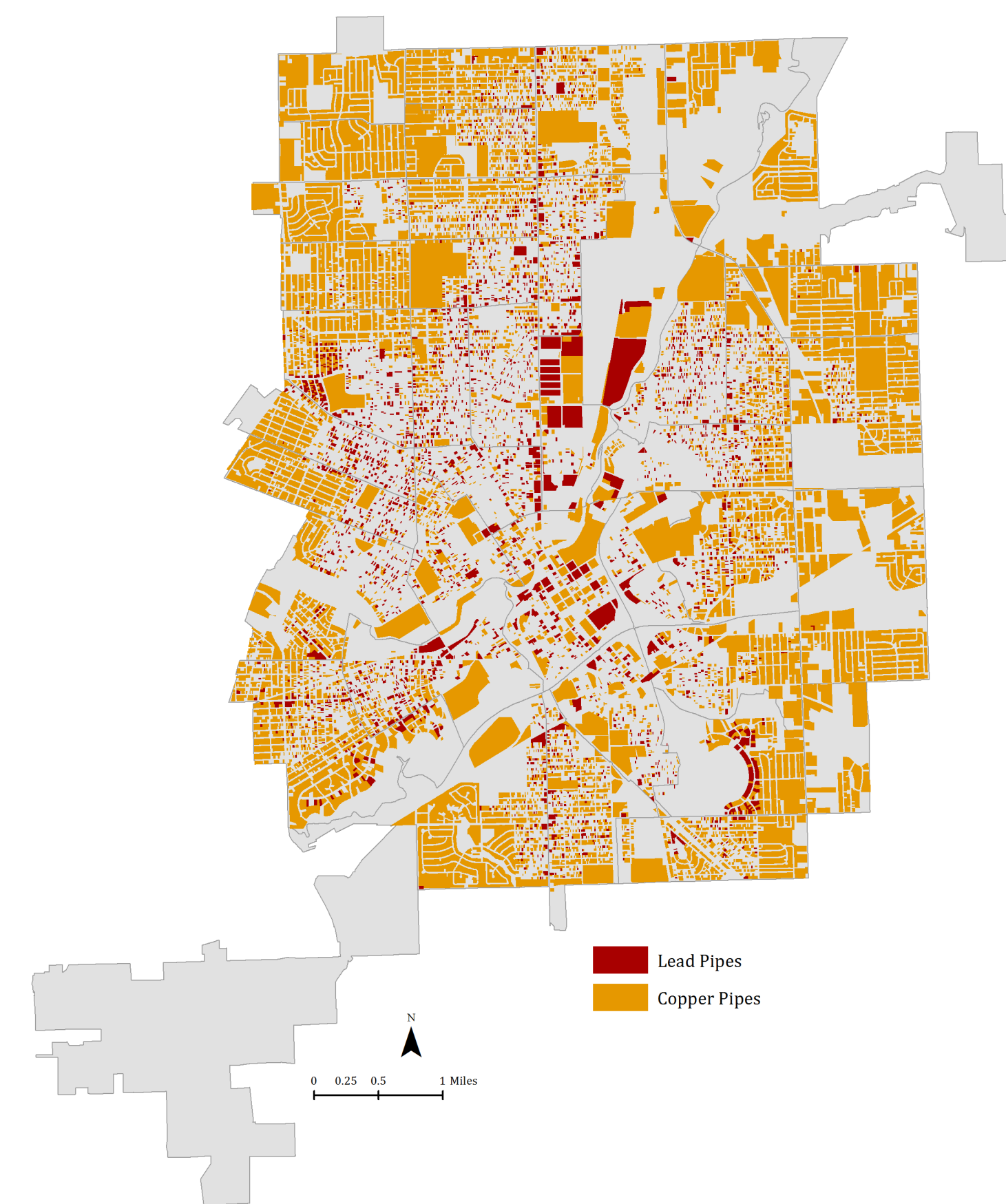


# Mapping Vulnerability and Water Contamination in Flint, Michigan

## BACKGROUND

In March 2013, the City of Flint decided to switch its primary water source from the Detroit Water and Sewerage Department (DWSD) to the Karegnondi Water Authority (KWA) to save money. In April 2014, the city began using treated water from the Flint River as its interim water source while KWA completed its development. They failed to provide treatment for corrosion-control to prevent lead buildups on the pipes, and residents immediately noticed a distinct odor and taste in their water. E.coli and total coliform bacteria developed by August and the city advised its residents to boil their water. By February 2015, Flint was found in violation of the Safe Drinking Water Act and multiple homes reported dangerously high levels of lead content. By October 2015, the Genesee County Public Health department declared a public health emergency.

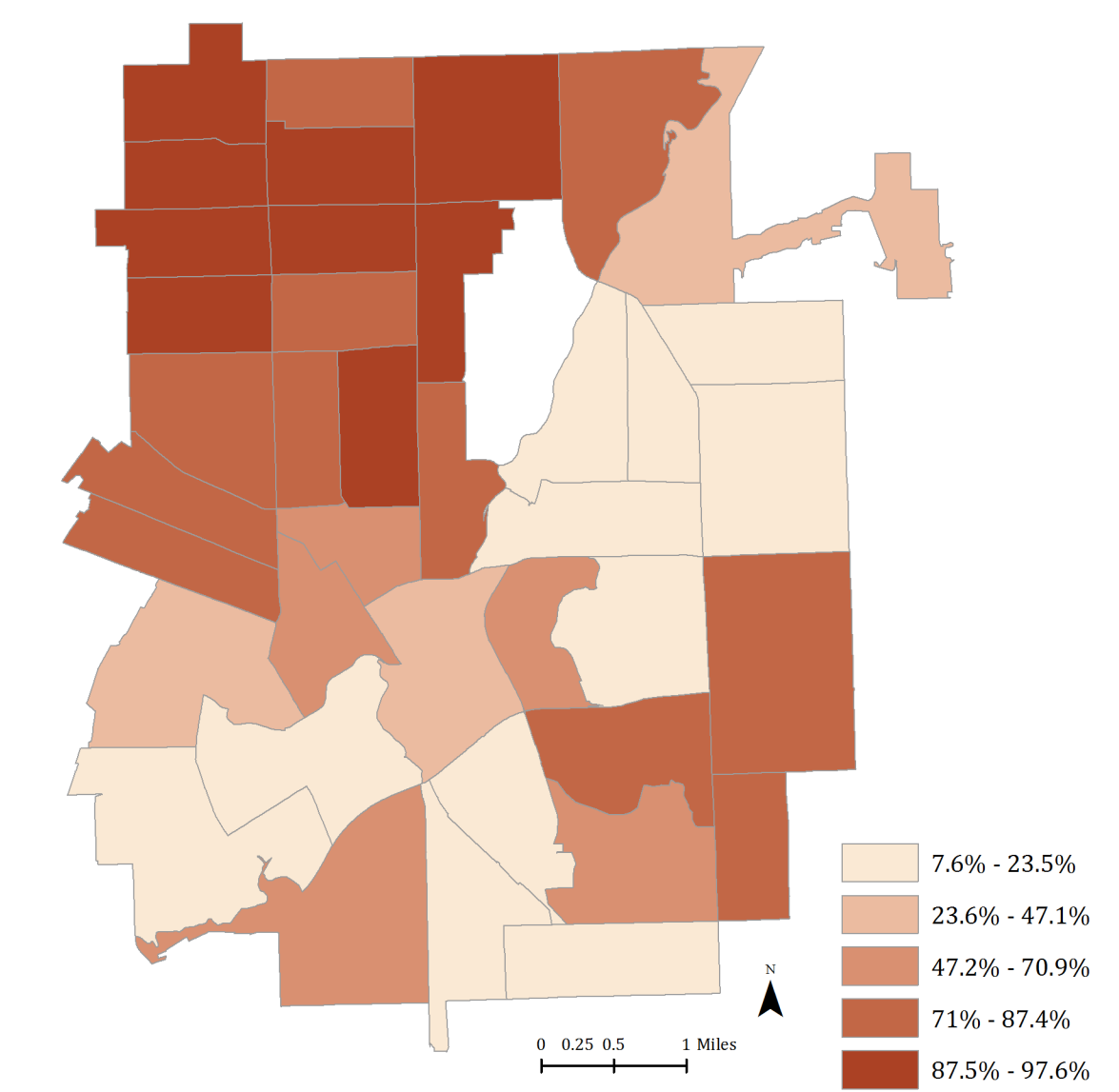
## CONTAMINATED PIPES



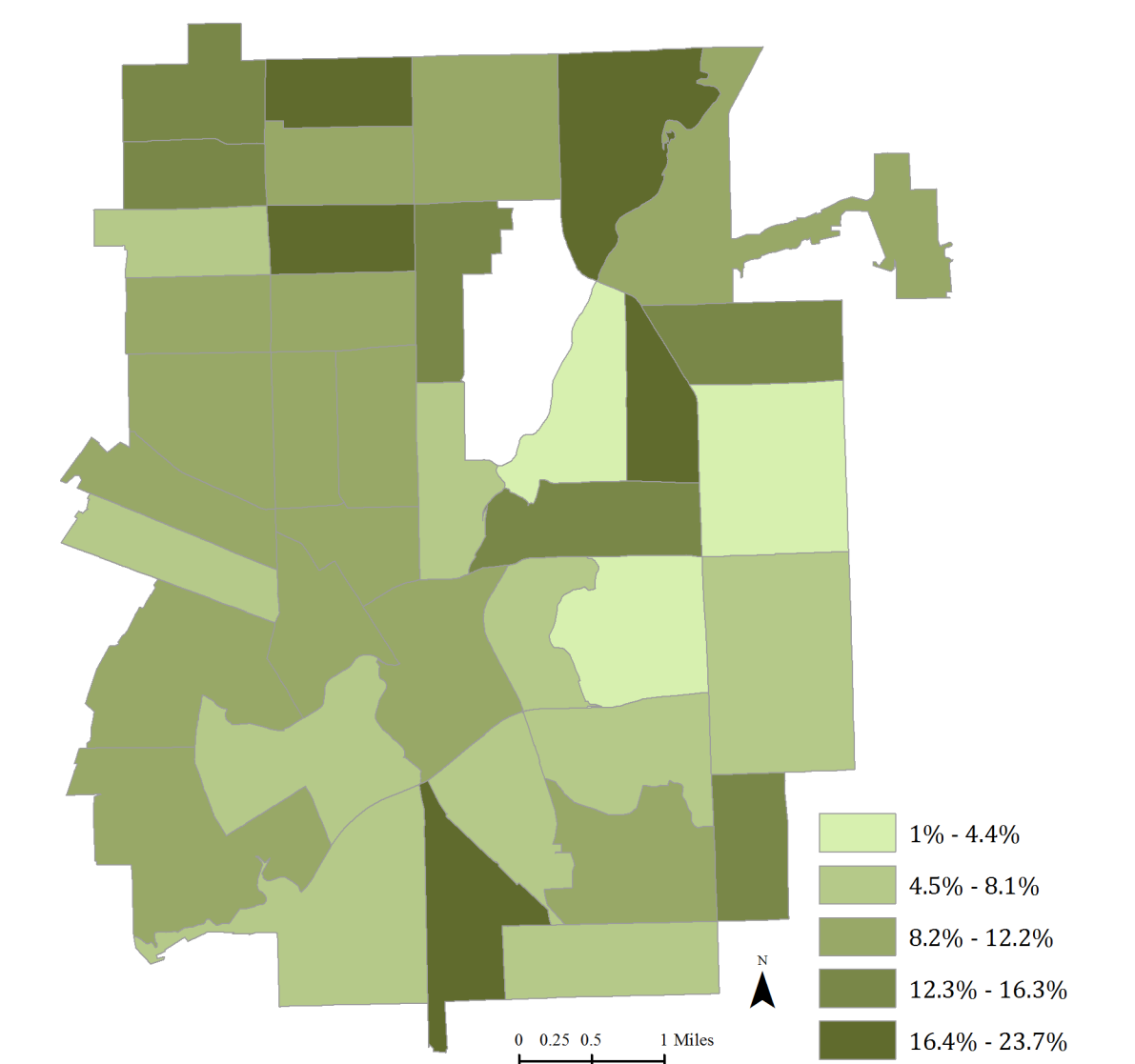
## RESULTS & LIMITATIONS

I had hypothesized that the most vulnerable communities would also be the sites of the worst water contamination. The results of the ACS data shows a clear clustering of multiple vulnerable communities in the upper northwestern neighborhoods of Flint. By comparing the median income and average house value to the neighboring parcels outside of the Flint boundaries, we see that Flint's property values and median income are significantly lower. In joining the pipe-level and household-level water data with the census data, I found that there is no significant correlation between vulnerable communities and highly contaminated pipes. The largest limitation I found was in collecting accurate water data. The City of Flint has been fairly transparent in publishing the results of community-generated testing, but there is no official body publishing city-wide test results. Thus communities that may be significantly burdened by completing their testing kits are unlikely to be represented in this data.

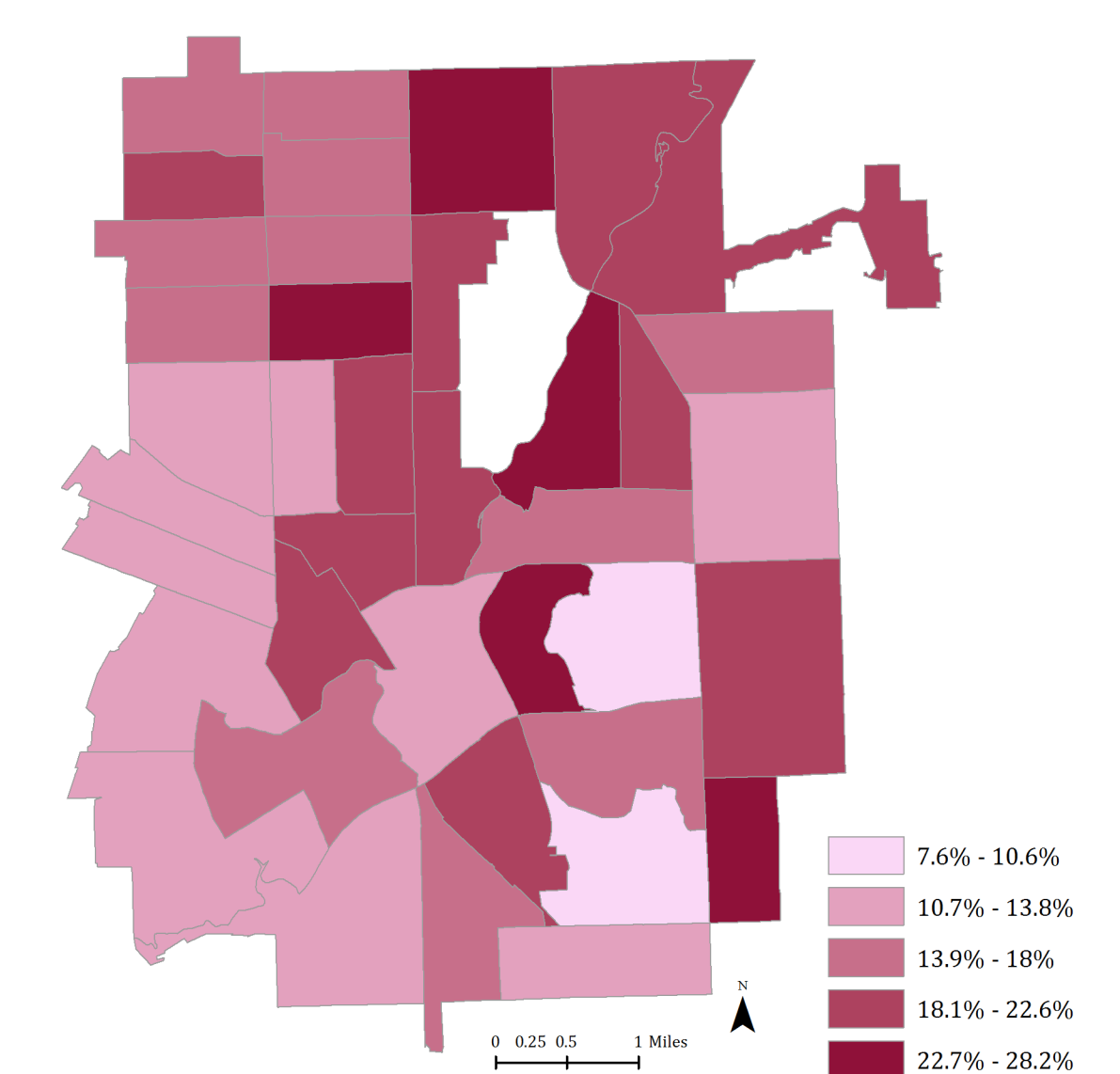
## BLACK POPULATION DENSITY



## BLACK UNEMPLOYMENT RATES



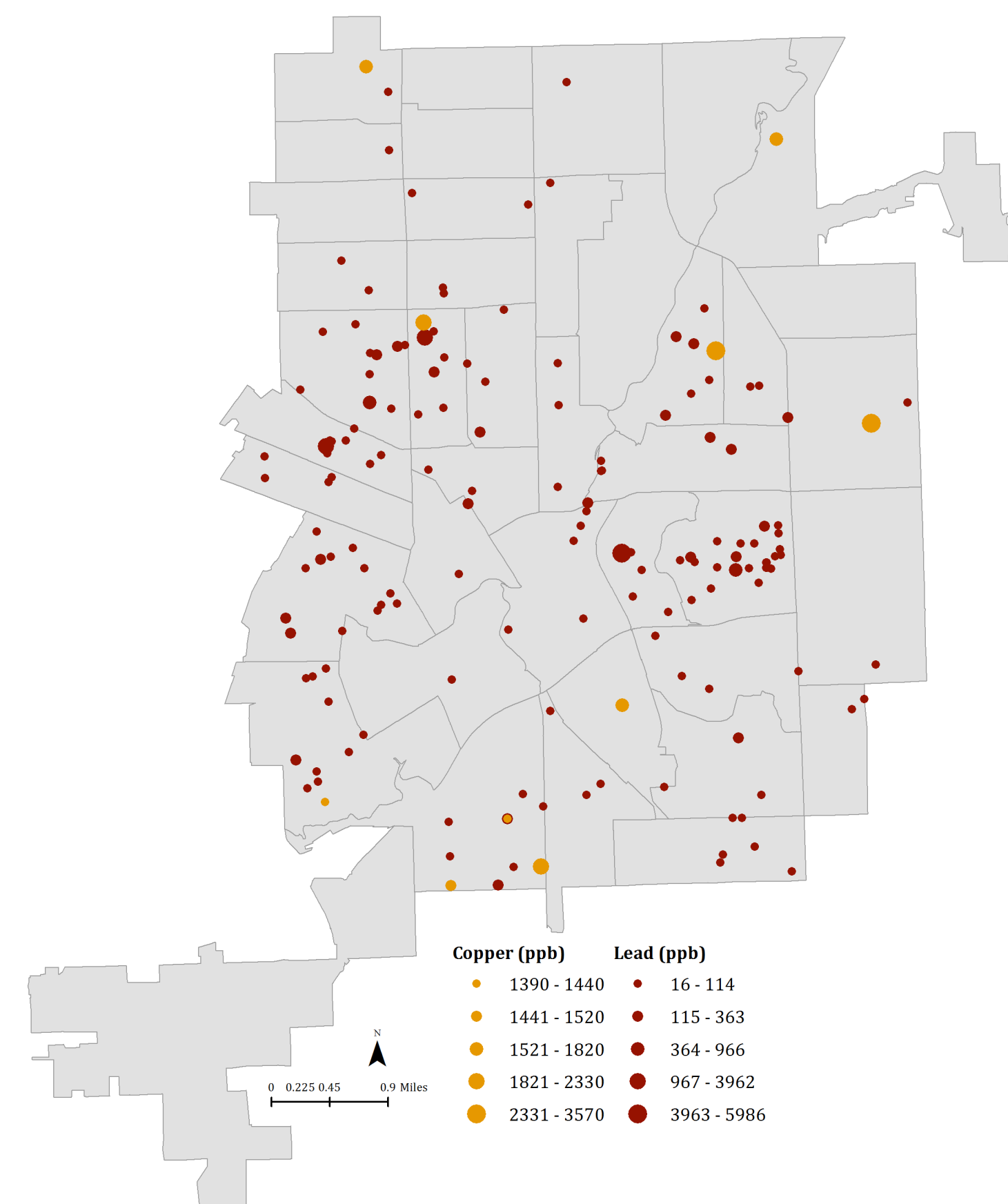
## POPULATION ON FOOD STAMPS



## METHODOLOGY

I first had to determine the location of vulnerable communities in Flint, MI. I joined American Community Survey 5-year estimate census data to the census tract polygons to identify the neighborhoods in Flint with the highest density of vulnerable populations. Next, I ran Local Moran's I tests on each vulnerability to determine clustering specifically within Flint, as well as including the surrounding tracts of Genesee County for comparison. Lastly, I used a parcel-level data set from the University of Michigan to determine where the copper and lead pipes were. I geocoded data points of community-generated water tests from the City of Flint depicting the current highest lead and copper levels. I performed a variety of joins on this water data to determine correlation or clustering within the vulnerable communities.

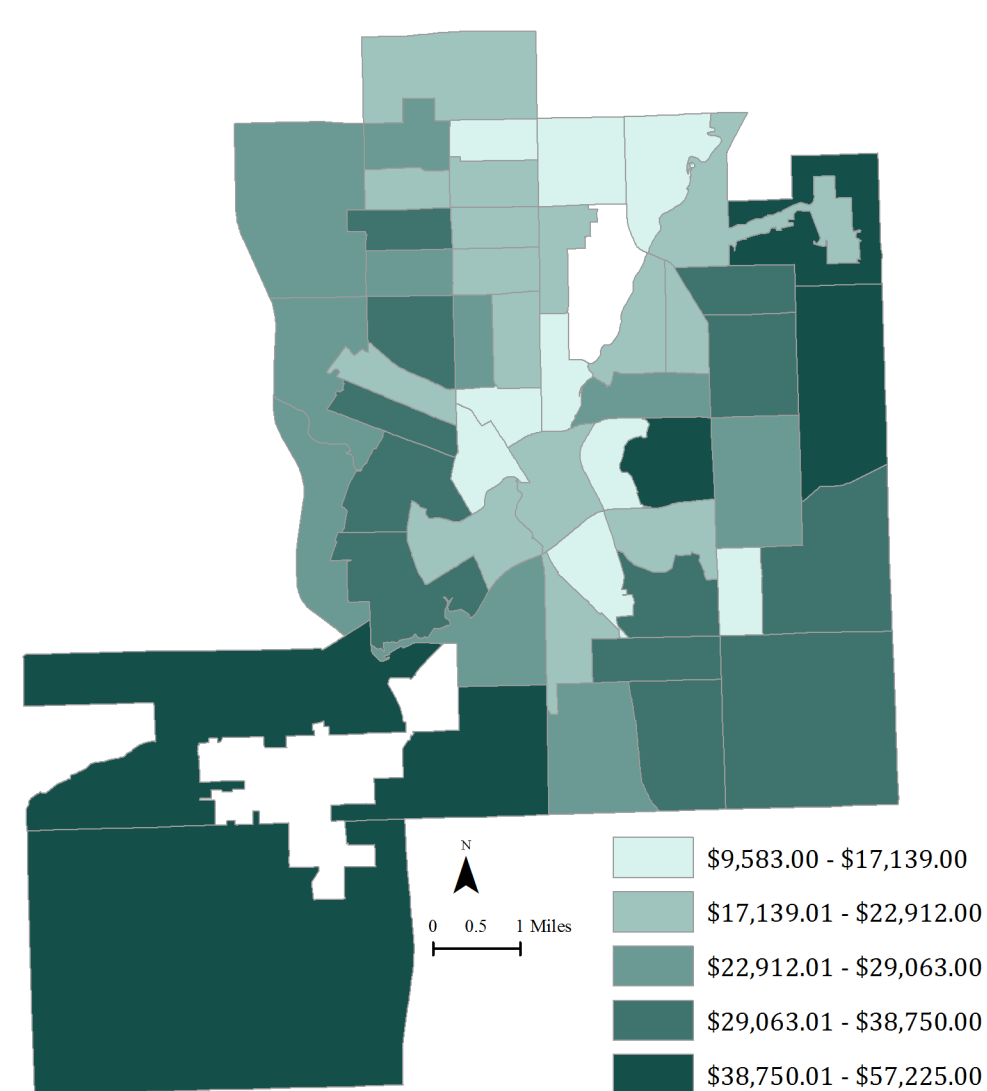
## COMMUNITY CONTAMINATION MEASURES



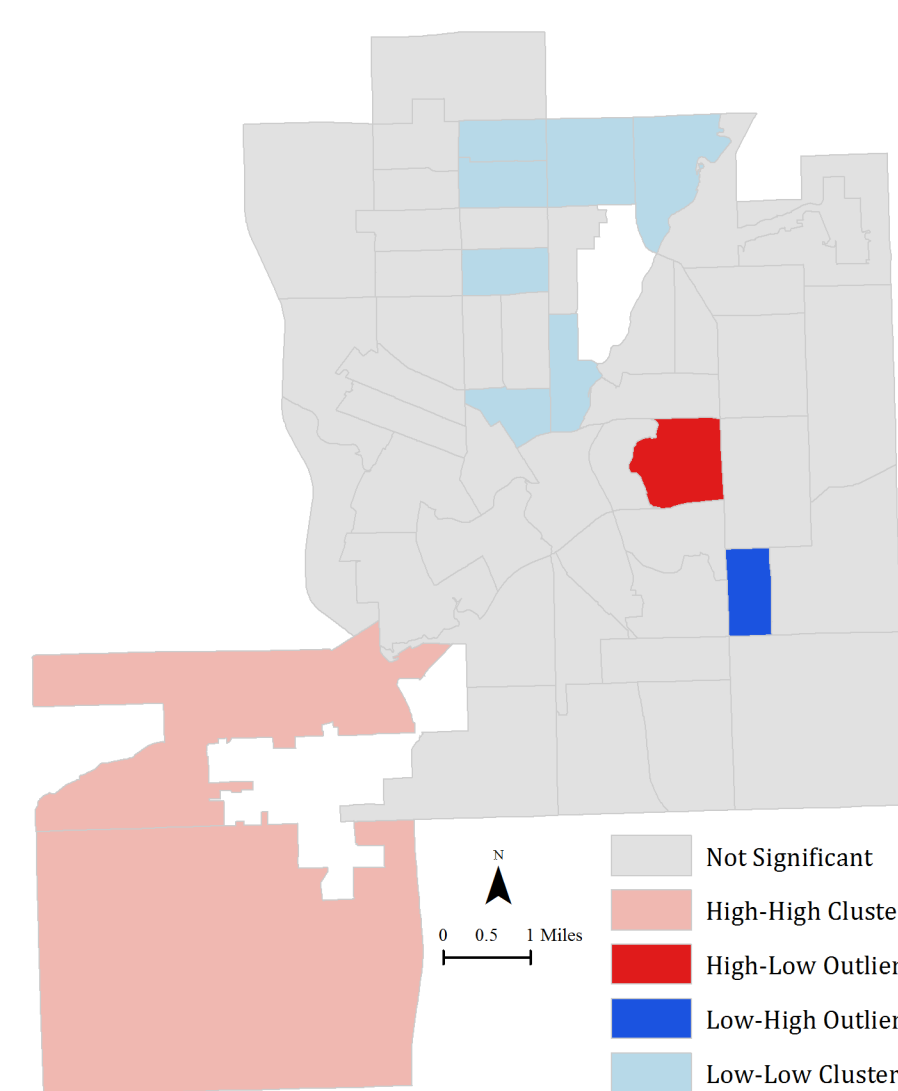
## DISCUSSION

Although it is possible that contaminated water is a widespread issue across all socioeconomic and racial groups in Flint, it is not possible to visually represent the inequalities of the burden of living with this contamination. Lower income families tend to live in older homes, which are at a higher risk of lead contamination due to their old infrastructure. Families that cannot afford to buy bottled water or who cannot easily access water distribution sites are likely to suffer disproportionately from Flint's elevated lead and copper levels. My research did not show what I had initially predicted, but it does depict the vulnerability of Flint compared to other surrounding cities, as well as the high levels of poverty and unemployment within the city. Flint's decades long economic crisis and discriminatory development laid the foundation for the city's complacency in using contaminated water sources. The racial fragmentation within Genesee county resulted in the vulnerable populations of Flint being disproportionately subjected to the environmental injustice of living without access to clean water.

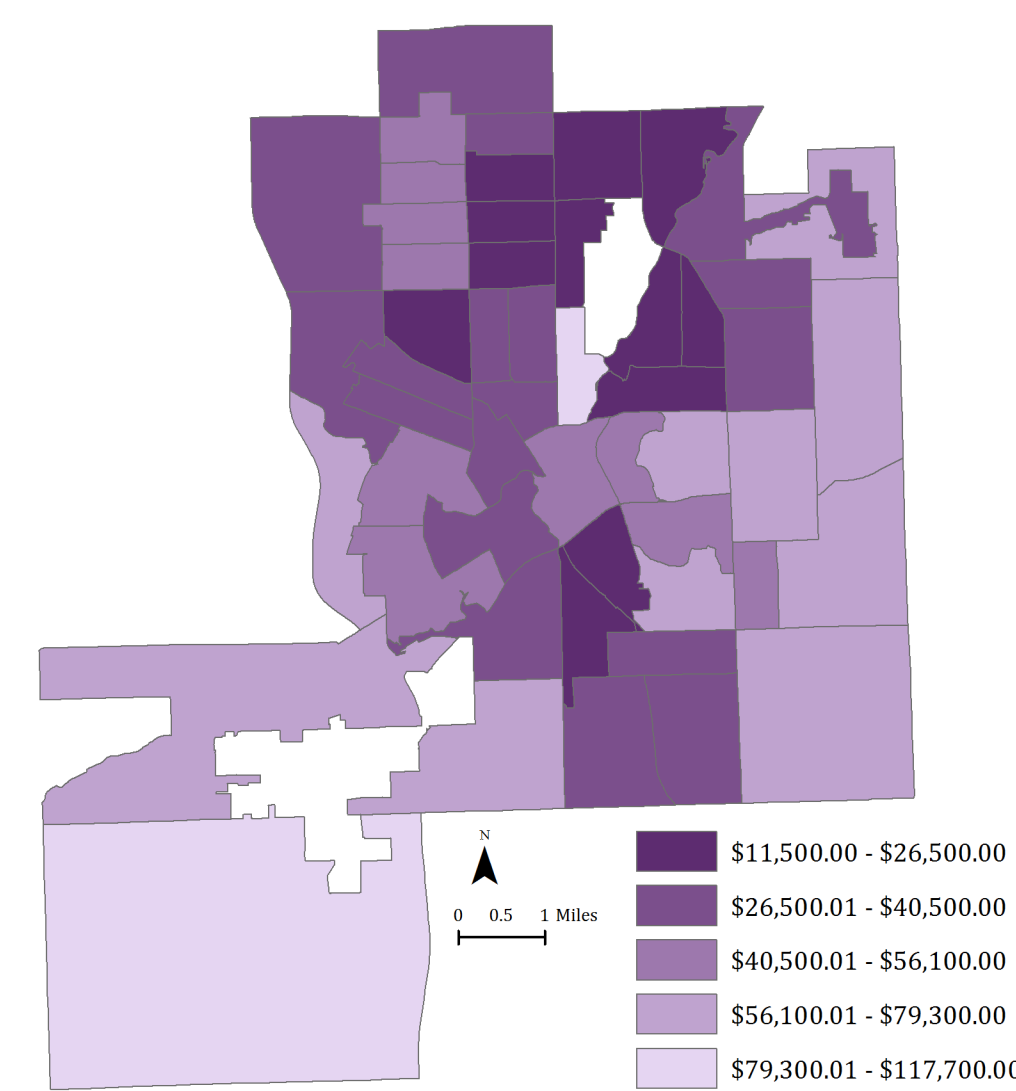
## MEDIAN HOUSEHOLD INCOME



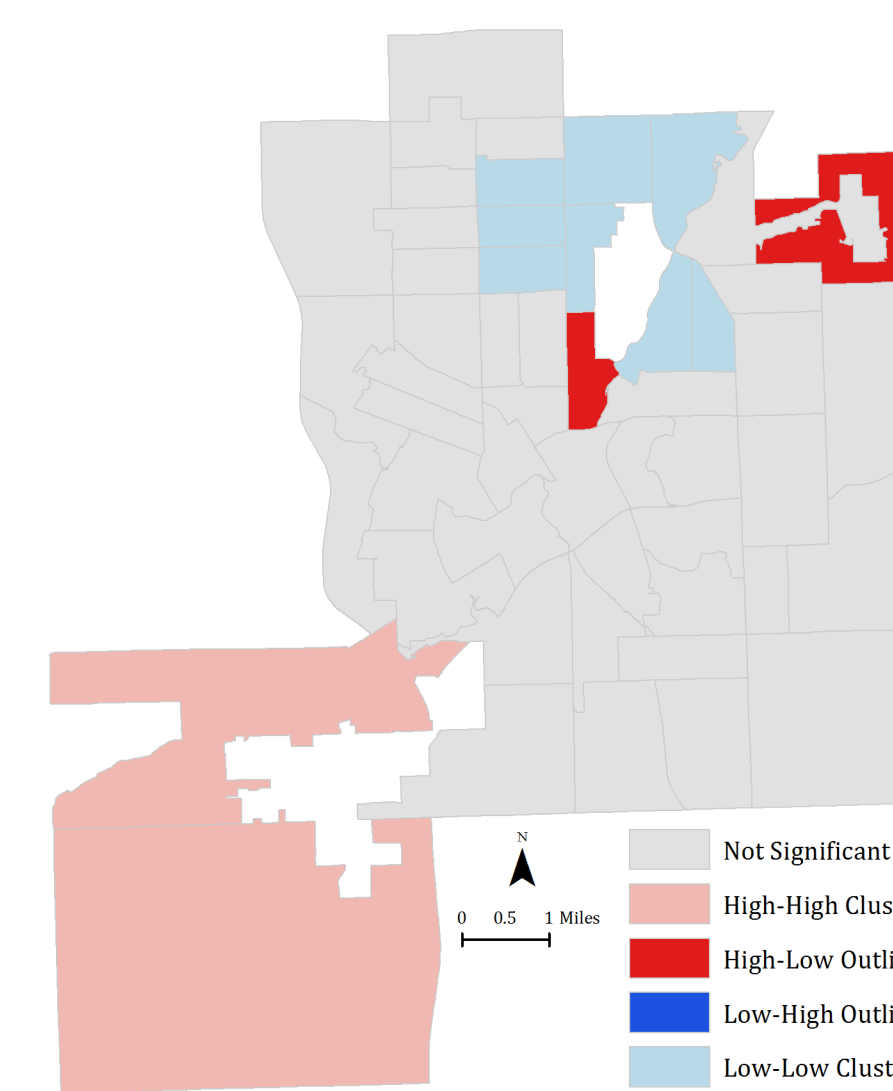
## LOCAL MORAN'S I: HH INCOME



## AVERAGE HOUSE VALUE



## LOCAL MORAN'S I: HOUSE VALUE



Neha Bhatia

GIS 101: Intro to GIS Fall 2016

NAD 1983 Michigan State Plane: Lambert Conformal Conic

Sources: Tufts GIS M Drive, ACS 5-Year Census Estimates, University of Michigan GIS Center, City of Flint, Detroit Free Press

