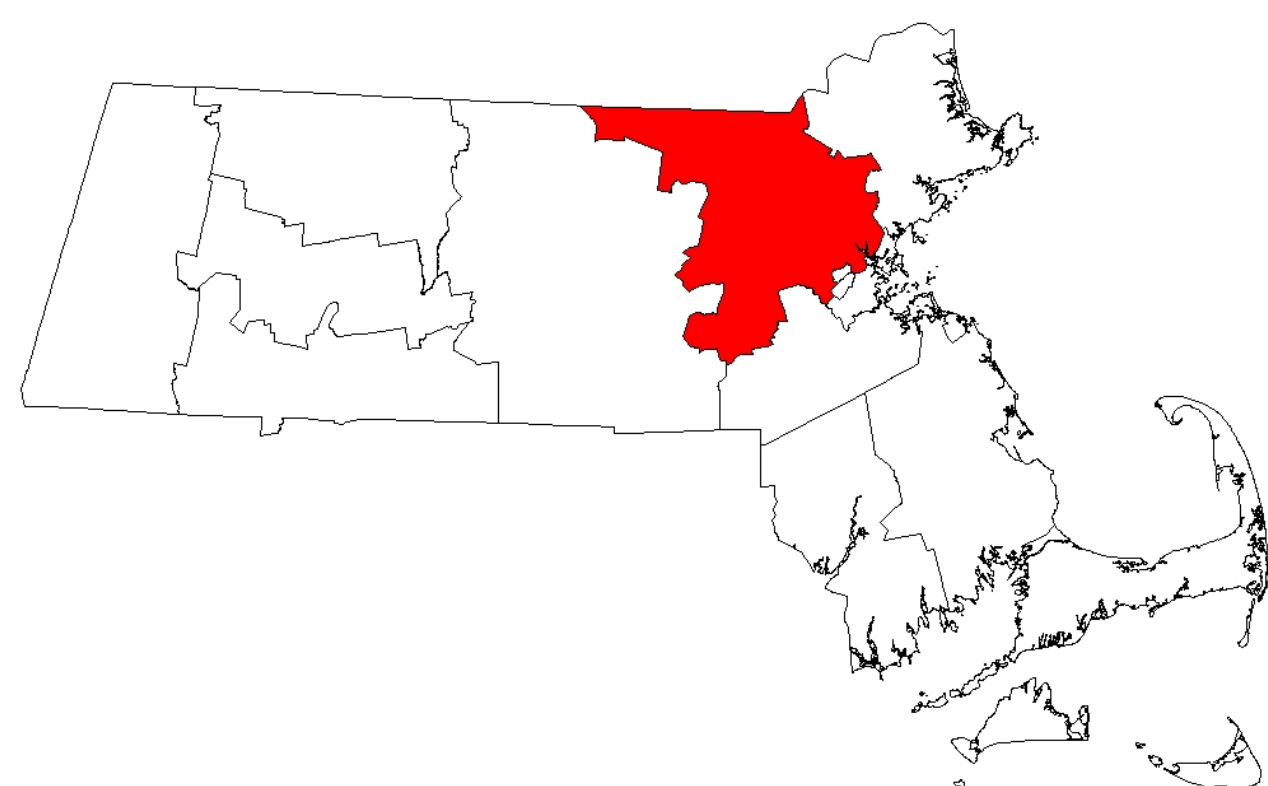


Density of Environmental Hazards in Middlesex County

Purpose

Environmental equity studies typically look at large scale sources of environmental hazards such as Toxic Release Inventory (TRI) sites, National Priority List (NPL) sites and solid waste handling facilities. These studies look at the distribution of facilities to see if certain populations are subjected to potential higher exposure from these facilities than other populations. In particular these studies investigate whether low-income and minority communities are more impacted by these hazards. Two major issues frequently arise in these studies. First, they tend to only focus on large sources of pollution yet urban communities typically do not have many large hazards but rather have a large number of small sources. Second, they typically only consider one type of hazard in the analysis, but a community may not be heavily impacted by one particular hazard. Instead they could be subjected to many different types of hazards. Failing to look at multiple hazards collectively gives an incomplete picture of hazard distribution. For these reasons this equity analysis focuses on the distribution of small sources and also incorporates several types of large scale sources in Middlesex County. This analysis determined which communities were the most impacted by the distribution of sources of environmental hazards and looked at population characteristics of these communities to see if minority and low-income populations live in areas with higher densities of environmental hazard sources.

Middlesex County, Massachusetts

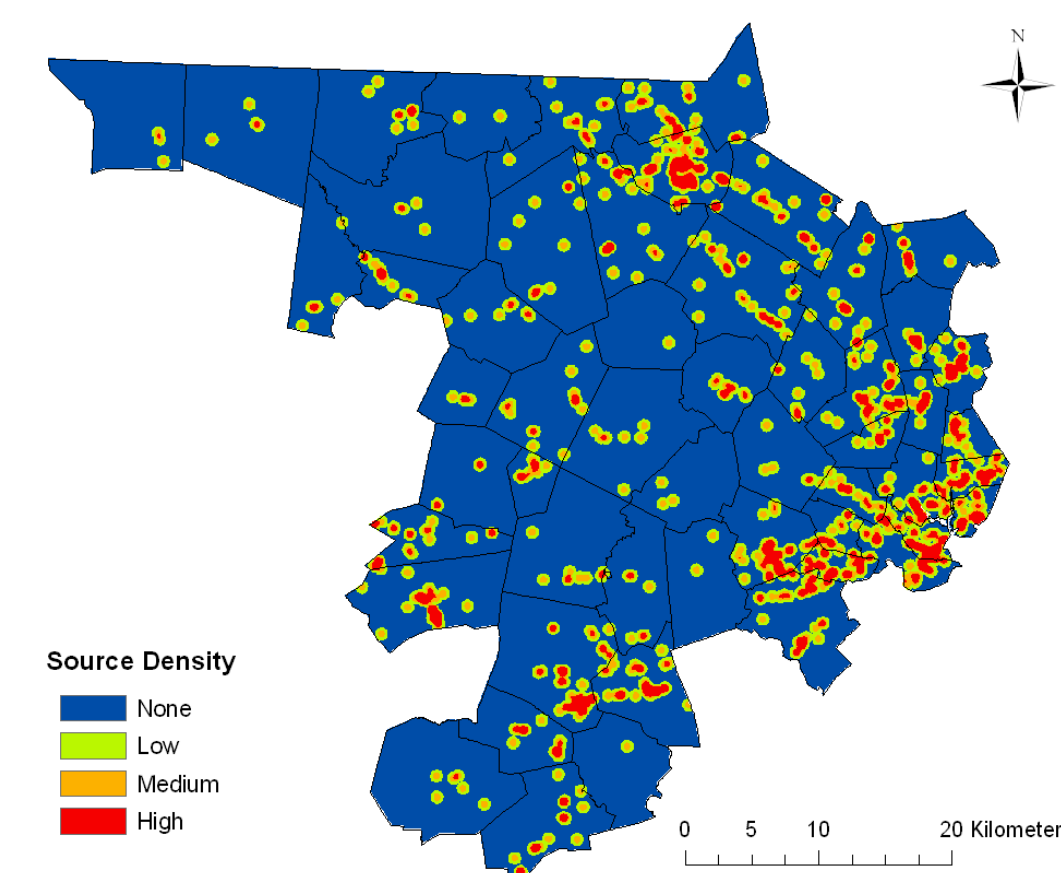


Methodology

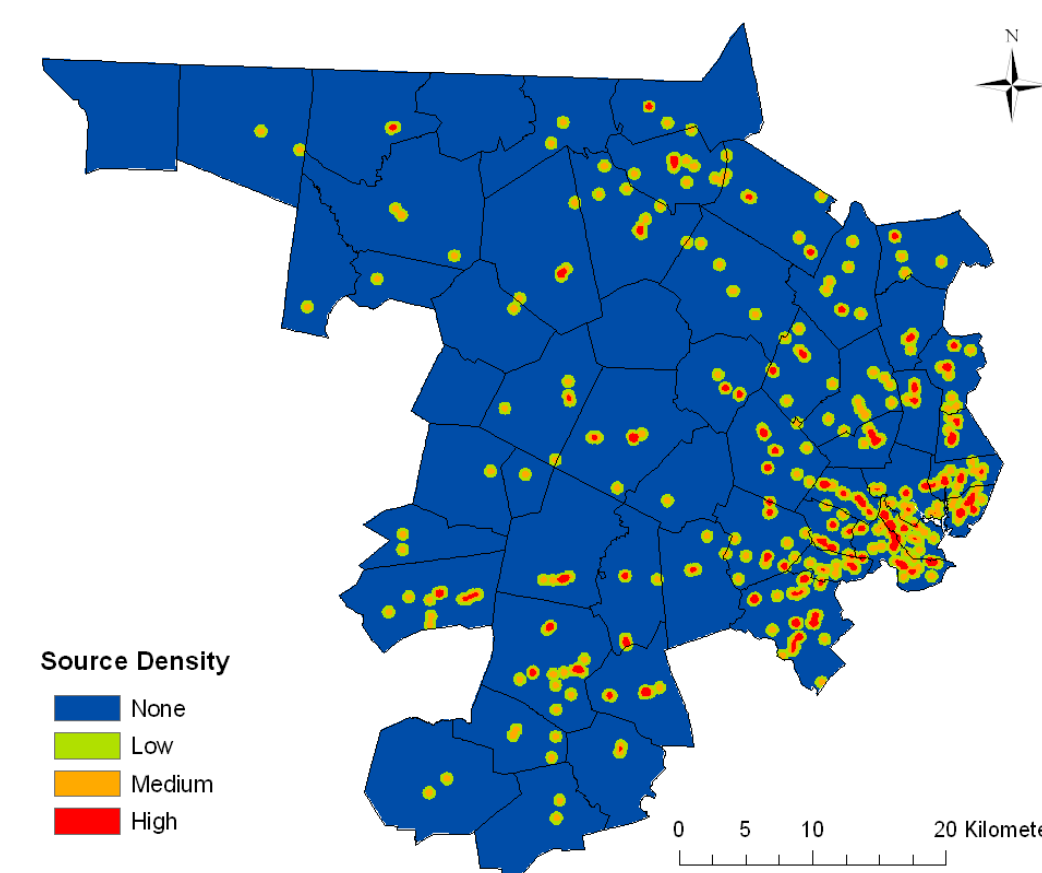
Source Distribution

Large and small sources in Middlesex County were identified and locations were mapped as points. Small sources in this analysis included gasoline service stations, auto body repair shops and dry cleaners. Large sources included TRI sites, NPL sites and solid waste facilities. Density surfaces were created for small and large sources separately using a cell size of 64 meters and a search radius of 500 meters for small sources and 1500 meters for large sources. These surfaces demonstrate the variations in source density throughout Middlesex County. As there are fewer large sources the large source density surface had much lower values while the small source surface had much larger values as there were more smaller sources, particularly auto body repair shops.

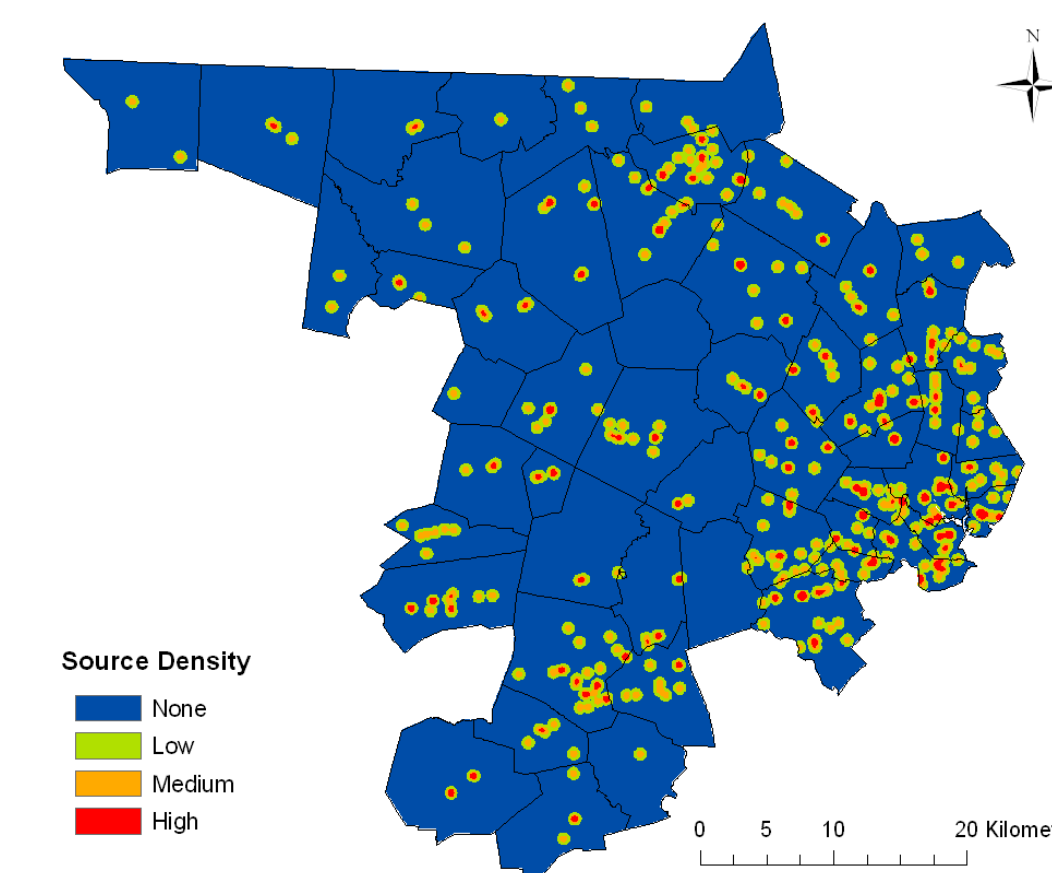
Density of Auto Body Shops



Density of Dry Cleaners



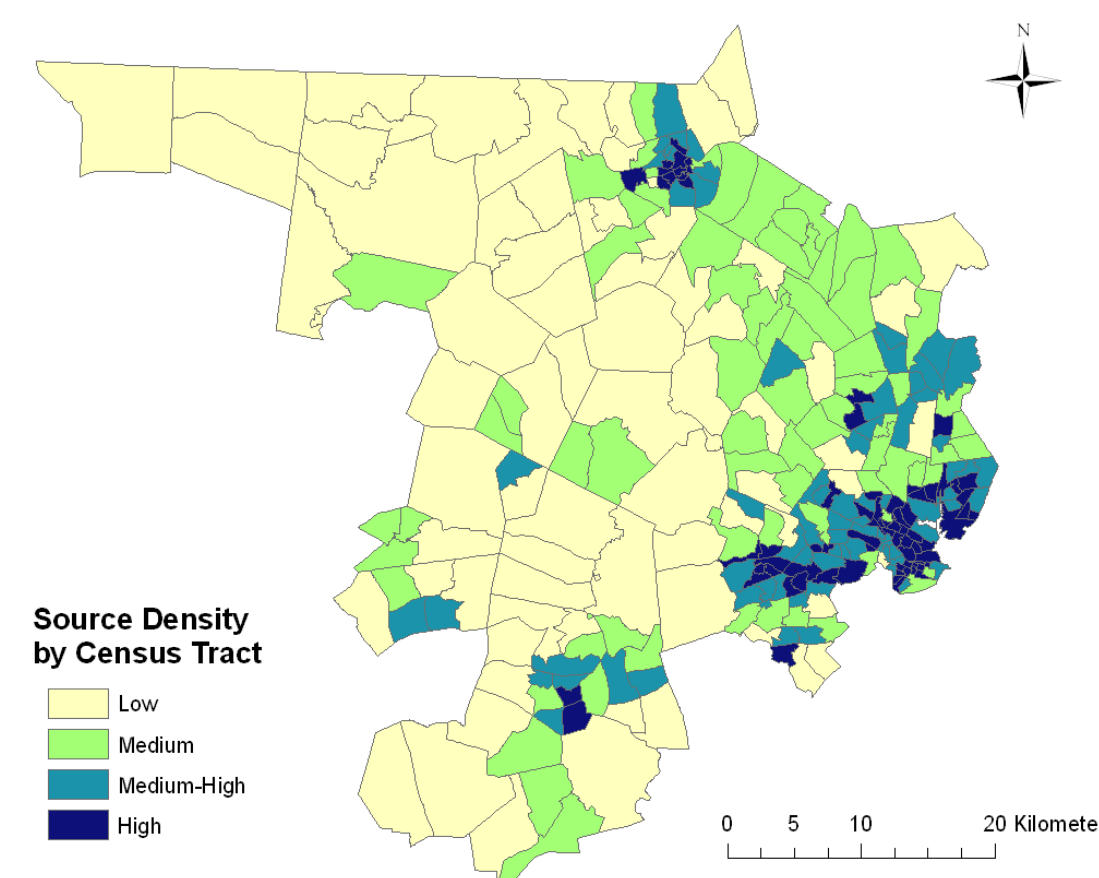
Density of Gas Stations



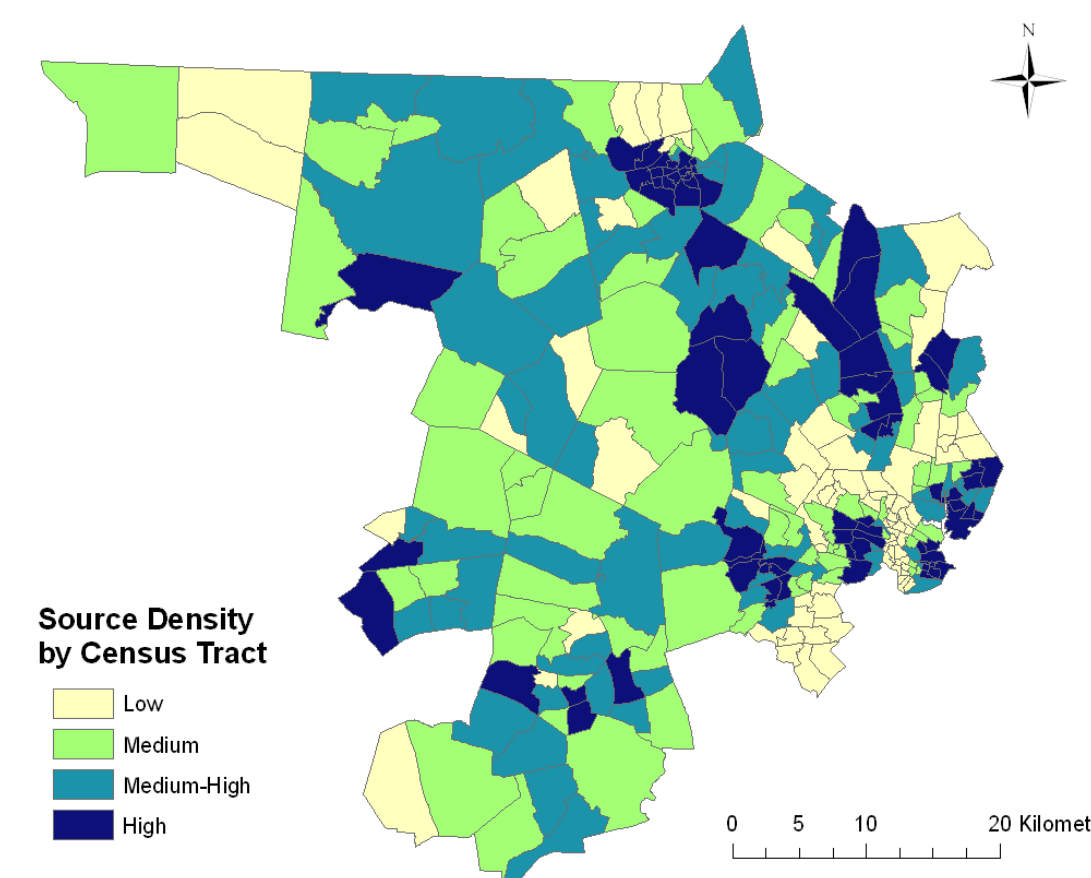
Zonal Statistics

Census tracts were then overlaid on the density surfaces for small and large facilities. The mean densities of large and small sources for each census tract were calculated separately. Tract mean densities were then divided into quartiles and ranked as low, medium, medium-high and high density. In addition, this was done for all facilities by adding the small and large source mean densities together and again categorizing tracts into density quartiles. In calculating the total density, large sources were weighted by a factor of three to account for the fact that large sources are likely to have a higher impact than smaller sources. It is important to note that quartile ranges varied greatly between large and small sources as the small source densities were much greater.

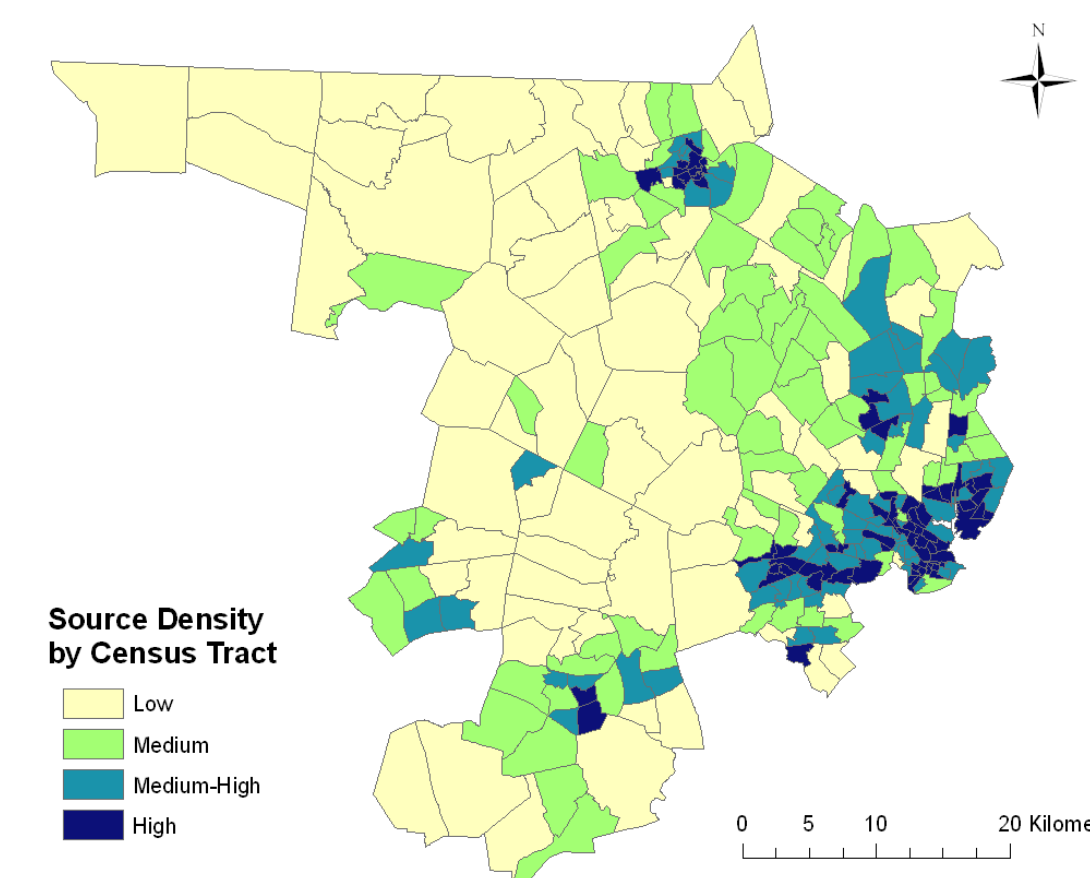
Distribution of Small Sources



Distribution of Large Sources



Distribution of All Sources



Impacted Populations

The density quartile ranks were then compared with income, level of education and minority percentages for census tracts. The means for each of these characteristics were calculated for each density rank for small, large and all sources.

Population Characteristics and Small Source Distribution

Density	Percent Population Over 25 with High School Education or Higher	Median Household Income	Percent Nonwhite Population
Low	92.8%	\$84,459	9.1%
Medium	90.9%	\$71,139	11.2%
Medium-High	87.4%	\$58,189	18.2%
High	79.4%	\$45,879	30.9%

Population Characteristics and Large Source Distribution

Density	Percent Population Over 25 with High School Education or Higher	Median Household Income	Percent Nonwhite Population
Low	91.8%	\$67,984	15.3%
Medium	89.5%	\$70,750	13.2%
Medium-High	89.9%	\$71,104	13.2%
High	79.3%	\$49,817	27.7%

Population Characteristics and All Source Distribution

Density	Percent Population Over 25 with High School Education or Higher	Median Household Income	Percent Nonwhite Population
Low	93.7%	\$85,844	9.0%
Medium	90.2%	\$69,460	11.0%
Medium-High	87.4%	\$58,595	18.2%
High	79.1%	\$45,448	31.4%

Conclusions

Tracts with higher source densities averaged lower percentages of the population over 25 with at least a high school education, lower median household incomes in 1999 and higher percentages of nonwhite populations. This was true when looking at small sources, large sources and combined sources. Overall, as source density increased, income and education level decreased while minority percentage increased. The density of small and combined sources resulted in the greatest variations in these demographics, while deviations for large sources were less intense. Thus it appears that the less educated, poor and minority suffer from the highest density of these hazard sources in Middlesex County.