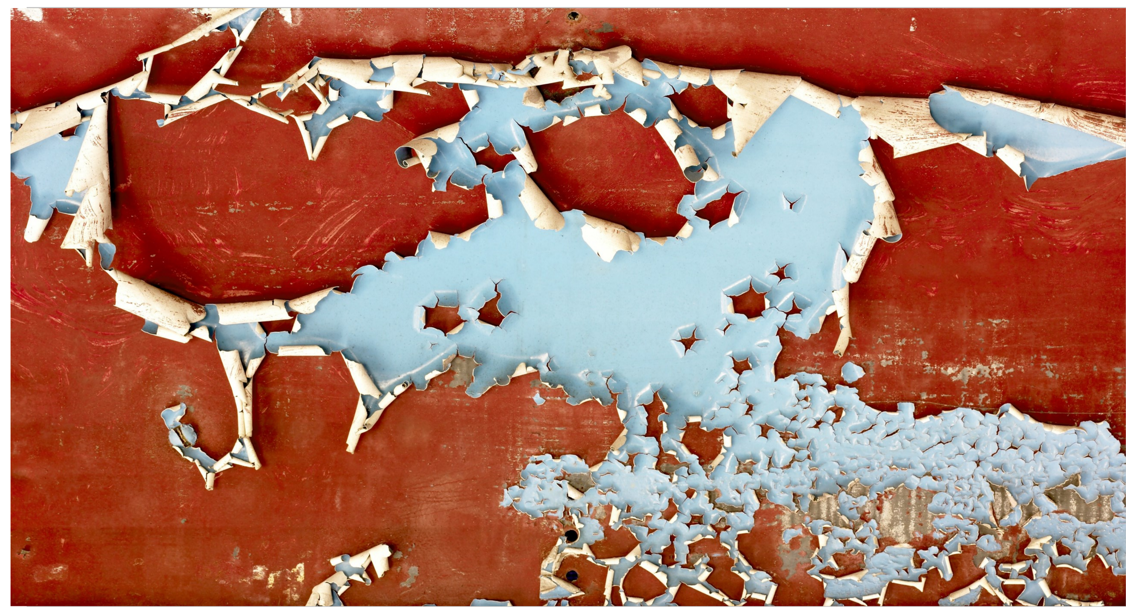
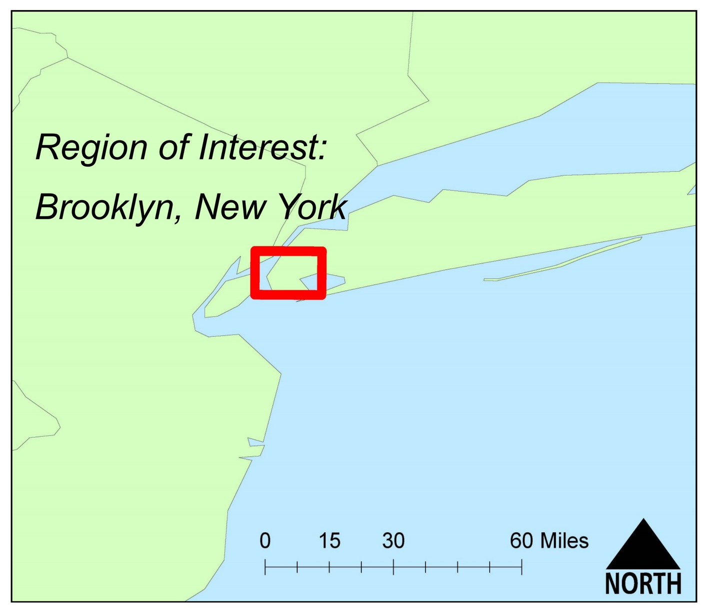


Lead Exposure:

Identifying High Risk Communities in Brooklyn, NY

Background



It has been long established in psychology, epidemiology, and neurotoxicology that exposure to lead - a neurotoxin - results in impairments such as brain damage, learning disabilities, decreased IQ, poor school performance, attention and behavioral problems, and decreased impulse control. These effects are especially profound in children, for whom even trace amounts lead exposure results in permanent harm.

Historically, the primary sources of lead pollution were through automobile emissions and from lead paint in homes. This is still of particular importance due to the persistent, bioaccumulative, and toxic nature of the substance. In other words, time will not remove the neurotoxin from the environment—only active cleanup efforts are capable of doing so—therefore, historical methods of exposure matter.

Due to the tremendous social costs lead exposure poses to society, it is of prime importance to accurately identify high risk regions to focus testing and cleanup efforts. This study focuses on Brooklyn, NY for its history of lead pollution, and for the history of political struggle for governmental assistance in cleanup.

Methodology

Risk factors used in this study are close proximity to major roads, large numbers of children in a given area, and age of home. These risk factors individually were considered according to the following charts.

Age of Home and Lead Risk*	
Year Home was Built	Estimated Percent Homes with Lead
1940 or earlier	87%
1940-1959	69%
1960-1978	24%
1979 or later	0%

**This risk analysis was done by sorting all homes in their respective age categories and multiplying the total number in each category by the estimated percent with lead pollution. The total estimated affected homes in each category were then aggregated for each census tract and Reclassified for five equal interval categories for the percent polluted homes.*

Proximity to Major Road and Lead Risk	
Distance to Major Road (meters)	Risk Factor (1-3)
0-50m	3
50-500m	2
500m and greater	1

Percent of Population Younger than Five Years Old	
Percent of Population < 5 years old	Risk Factor
12-22%	5
8-12%	4
5-8%	3
2-5%	2
0-2%	1

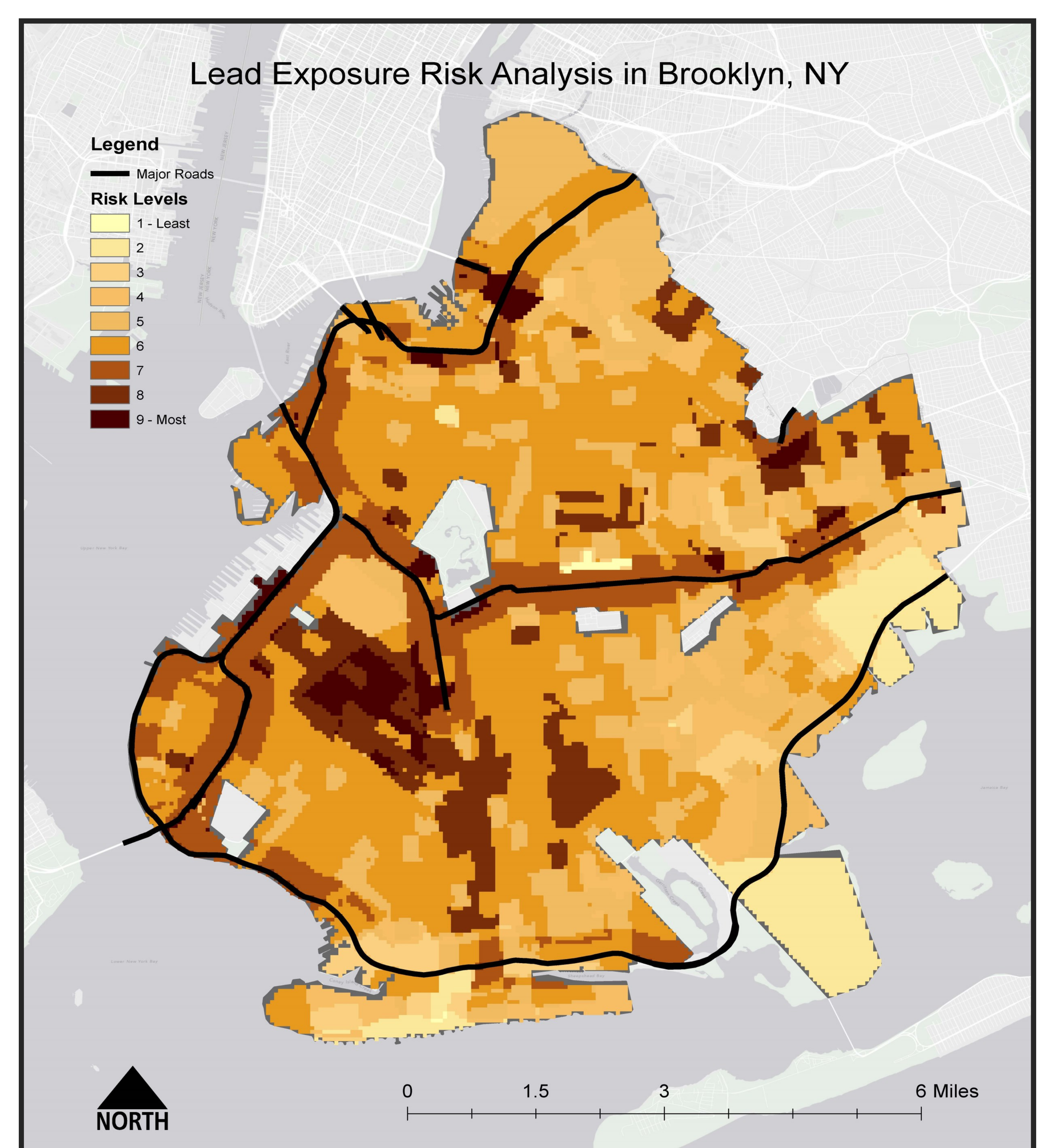
The final risk analysis was completed with these three variables weighted at 40%, 20%, and 40% respectively. This wad chosen according to probability of exposure due to each variable individually as discovered through research on both lead exposure specifically and from research on similar toxic molecules and ambient particular matter.

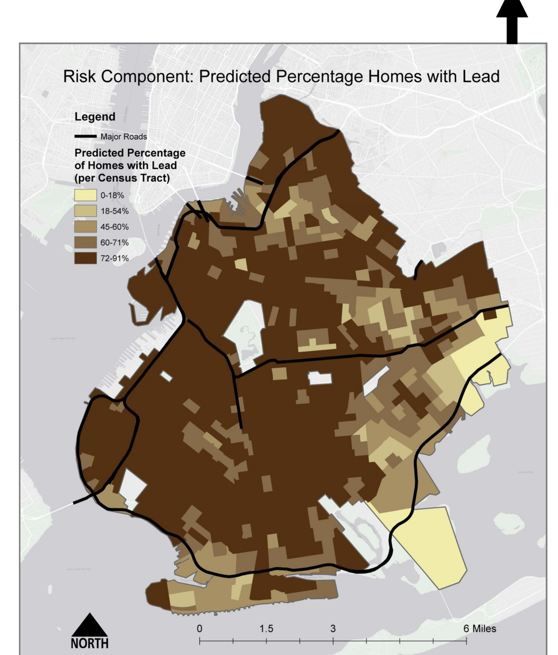
Lead was formerly used in very high concentrations in paint for residential use, and this concentration declined with the decades until it was outright banned in 1978. Lead remaining in the paint of old homes is a significant contributor to modern lead exposure—with approximately 80% of child exposure cases occurring in the home—making the age of home a key variable to consider in this risk analysis. Proximity to major roads is also important, as leaded gasoline was only phased out in the 1970s and still remains in the soil near the roads commonly traveled before the phase-out. Therefore, proximity to major (pre phase-out) roads is the second key variable. Third is population of young children in a given area, because they are by far the most biologically vulnerable population to lead's harmful effects, and even trace amounts of the substance need to be taken seriously.

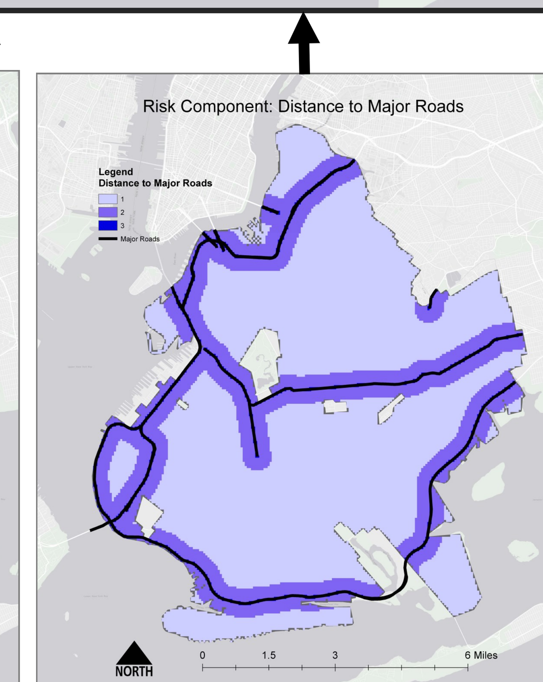
Major tools used in processing this analysis were Euclidean Distance, Field Calculator/ Statistics, Reclassify (for appropriate risk values according to prior research), Raster Calculator, and Minus/Differencing.

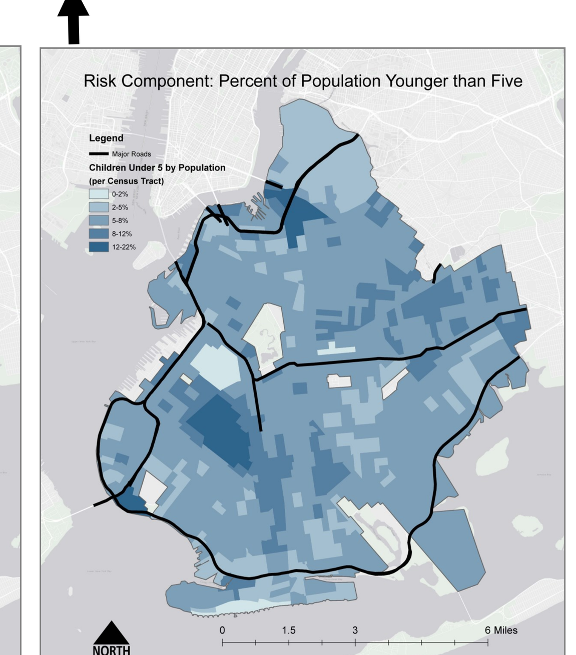
Results

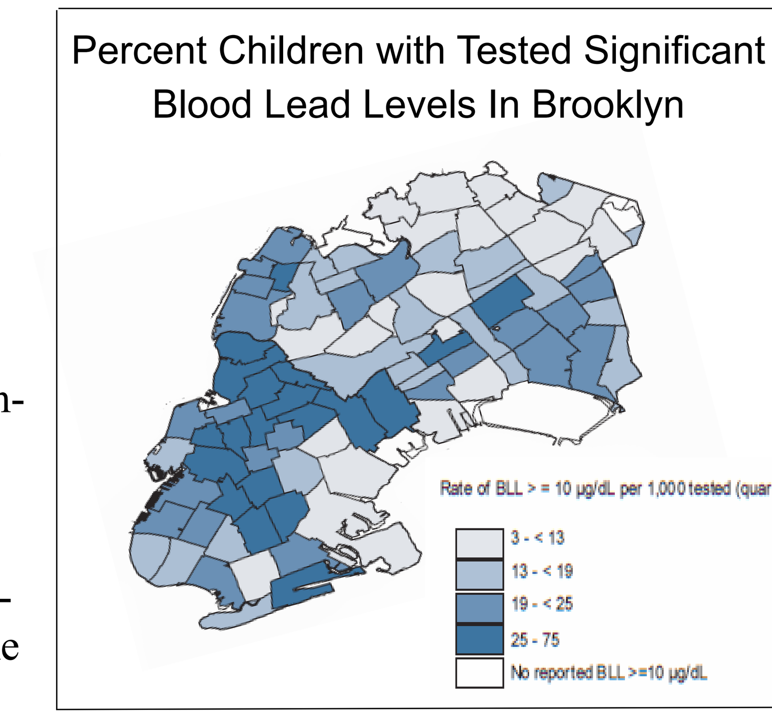
The following maps demonstrate how each risk factor comes together for a larger risk analysis of lead exposure in Brooklyn, New York.



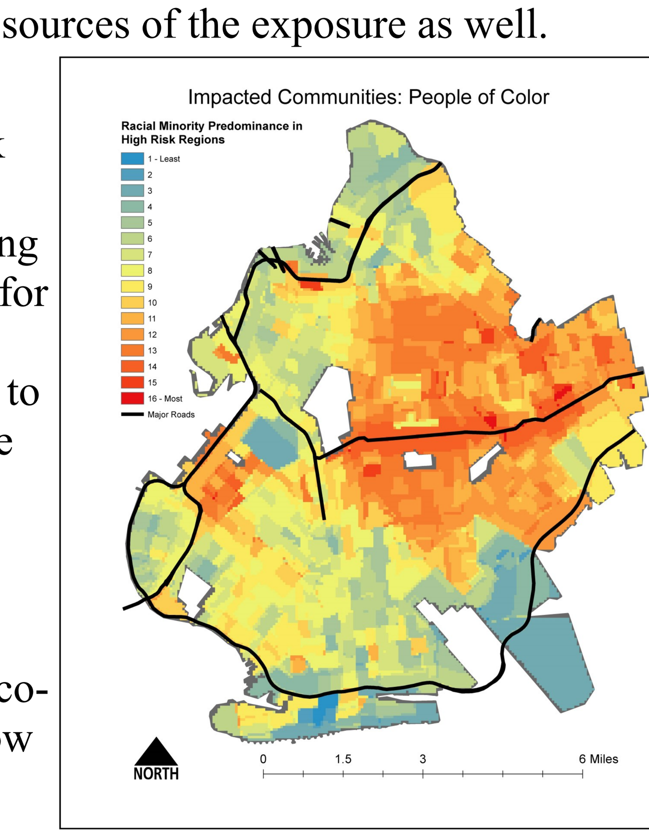






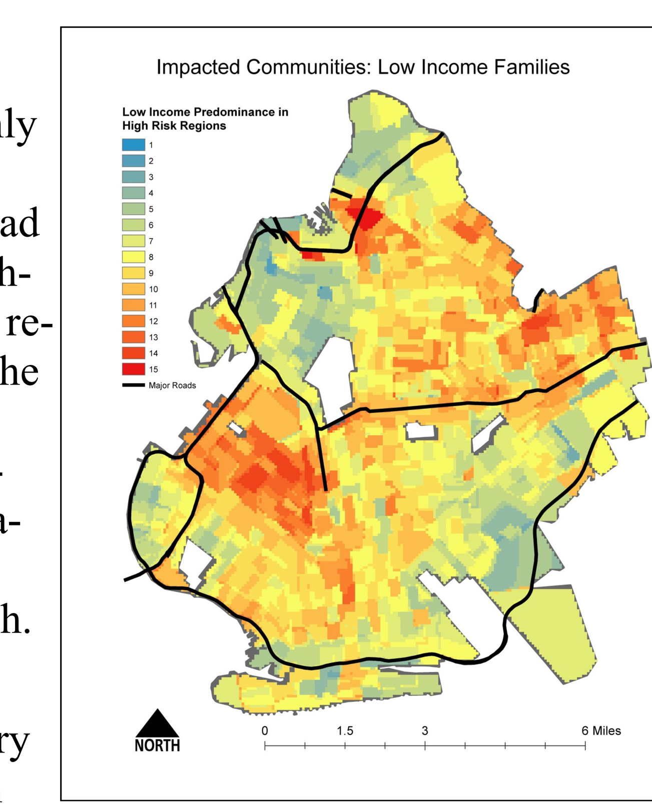


The predicted highest risk regions are significant because the model mirrors regions with historically elevated blood lead levels: East New York, Bedford Stuyvesant-Crown Heights, Downtown-Brooklyn Heights-Park Slope, Williamsburg-Bushwick, East Flatbush-Flatbush, Jamaica, and Southwest Queens (as shown in the map to the right, from the New York Department of Health and Mental Hygiene). Because the risk variables in this model are able to produce these results with some accuracy, we can use the input variables considered in this analysis as a means of directing the focus not only on particular geographical regions of high exposure, but also on particular sources of the exposure as well.



Another avenue considered in investigating high risk communities for lead exposure are not only finding specific neighborhoods, but populations as well. Using Differencing, high risk region values were adjusted for the population of non-white and low income people living there. The results can be seen in the two maps to the right. As can be seen visually, there are very large regions where low income populations reside which coincide with high lead exposure risk levels, and a smaller number of regions which coincide with non-white race predominance. This finding goes against common assumptions that high risk neighborhoods coincide with non-white neighborhoods. Rather, it is low income neighborhoods which are the most affected.

Conclusions & Suggestions



The major findings of this project were that using only the variables of home age, proximity to major roads, and child population, a fairly accurate mapping of lead exposure risk can be achieved. The highest risk neighborhoods were identified and closely mirrored those regions of historically high blood test levels. Further, the regions which have the highest risk of lead exposure are very commonly low income neighborhoods. Predominantly non-white neighborhoods are not as reliably impacted by high lead risk levels, which goes against current assumptions in lead exposure research.

Constraints on this project consistently rose from very limited access to lead exposure data. Future research would focus on gathering long term data of that nature specifically to track time series trends in community exposure. Research could also compare the highest risk regions with current governmental cleanup efforts, to track efficient and inefficient use of resources.

References

K. Murphy
GIS 101: May 4, 2014
Projection: NAD 1983 StatePlane New York East FIPS 3101 (Meters)
Scale: 1:42,000
Data Sources: American Community Survey 2010 – Tables SF1DP1, B25034, DP03; TIGER New York Census Tracts (Accessed April 10, 2014)

Tufts