

Mapping Air Pollution and Asthma in the Bronx, New York City

Lehman College/City University of New York, NOAA-CREST Team

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Project Description:

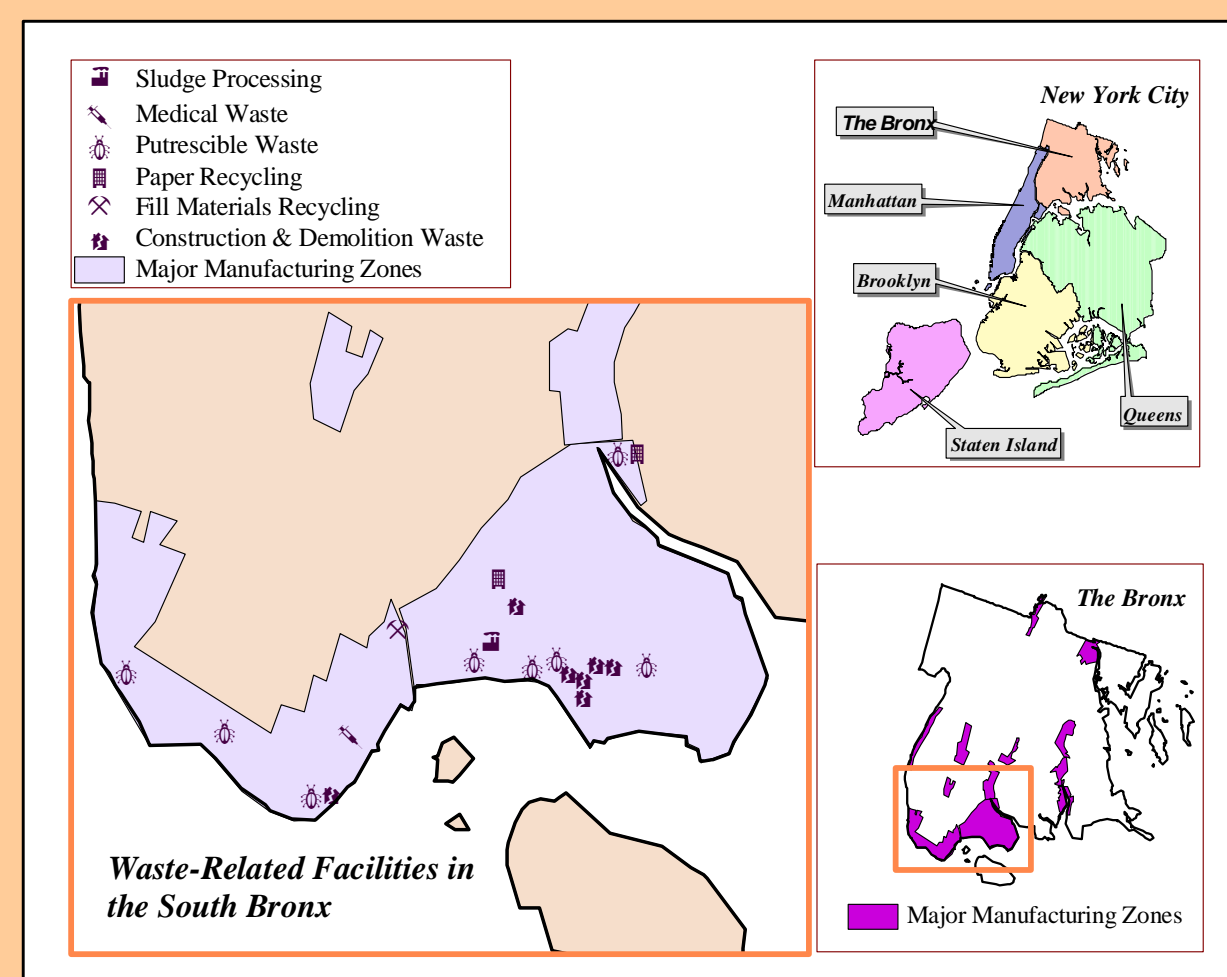
The NOAA-CREST research project underway at Lehman College, *Mapping Air Pollution and Asthma Incidence in the Bronx, New York City*, examines the spatial correspondence between the incidence of asthma and the locations of environmentally-burdensome land uses and activities. We propose that there is a spatial correspondence between areas having high rates of asthma hospitalization and areas with high levels of air pollution, even after controlling for race/ethnicity and income. To test this hypothesis, we are using Geographic Information Systems (GIS) to map and model the major mobile and stationary sources of air pollutants in the Bronx, New York City. Environmental Systems Research Institute's "ArcView" mapping and spatial analysis software is being used, as well as specialized data sets, orthophotos, and geostatistical programs.

Recent studies ¹⁻⁹ have linked high concentrations of known air pollutants to respiratory disease, demonstrating that increased air pollution is a serious public health and environmental concern. Reduced air quality and respiratory health problems, particularly asthma, have been associated with a number of sources, including toxic air emissions from industrial processes, particulate matter and increased levels of NO_x and SO_x from truck traffic, and increased pollution from other noxious land uses (e.g. waste-related facilities, medical institutions, power plants).

These issues are of particular interest to the Lehman College community, because residents of the Bronx, specifically children under the age of 14, suffer from one of the highest rates of asthma hospitalization in the country¹⁰. In addition, the Bronx has a disproportionate number of solid waste transfer stations and TRI facilities¹¹, and these are mainly concentrated in the South Bronx, where the asthma rate is relatively high. The South Bronx also has the highest volume of vehicular traffic in the nation, which greatly lowers air quality¹². There have been no major geographic studies of New York City that have addressed the potential connection between noxious land uses and asthma. Therefore, we are investigating the possible correlations that may exist between high rates of asthma and multiple sources of air pollution in the Bronx.

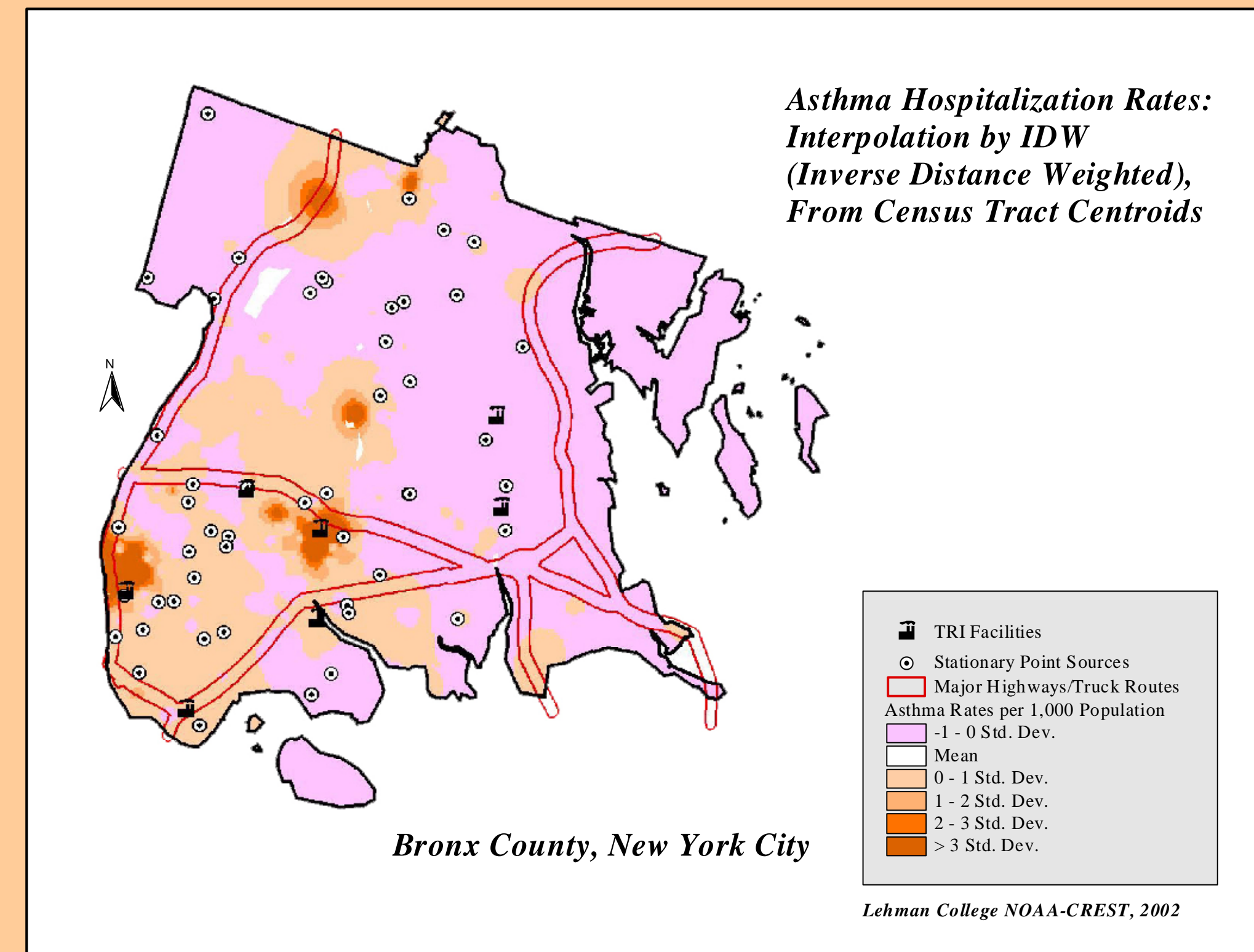
We are addressing the following questions using the methods discussed below:

1. What are the major sources of air pollution in the Bronx?
2. For each source, what are the quantities and characteristics of pollutants emitted?
3. What is the geographic extent of pollutant dispersion (impact zone)?
4. What are the characteristics (socio-economic and racial/ethnic) of populations potentially most affected by these pollution sources?
5. Is there a spatial correspondence between areas having high asthma hospitalization rates and areas with high emissions of air pollution?
6. What types of pollution sources (mobile and/or stationary) contribute most to high rates of asthma hospitalization?
7. Is there a connection between race/ethnicity and/or income and high asthma rates?
8. If there is a spatial correspondence between high asthma rates and air emissions, and we control for race/ethnicity, is the correspondence significant?



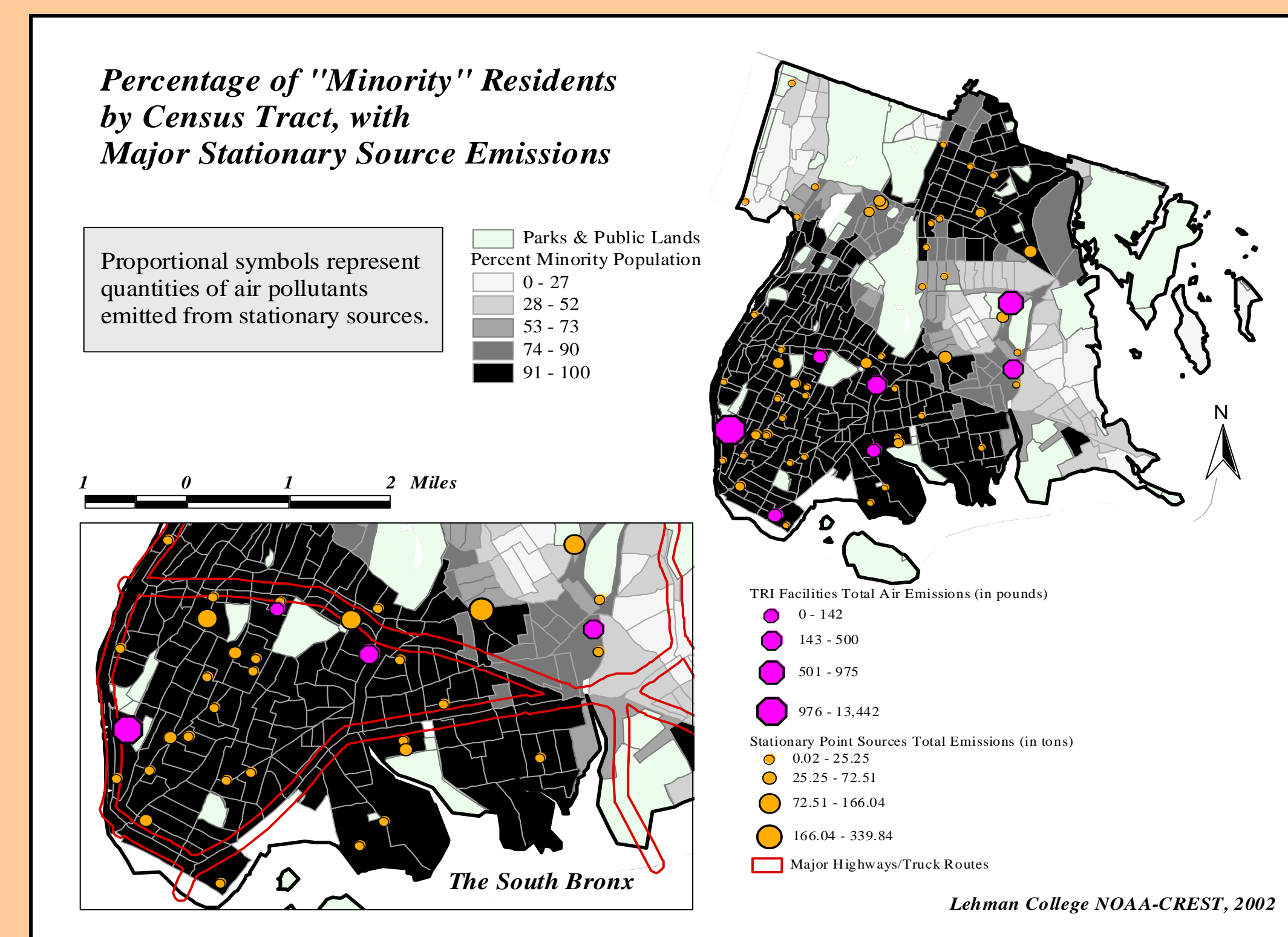
Orthophoto of the South Bronx. (Aerial photo with planimetric shift correction.)

Orthophotos, taken in 2000, were utilized to create the official basemaps of New York City.



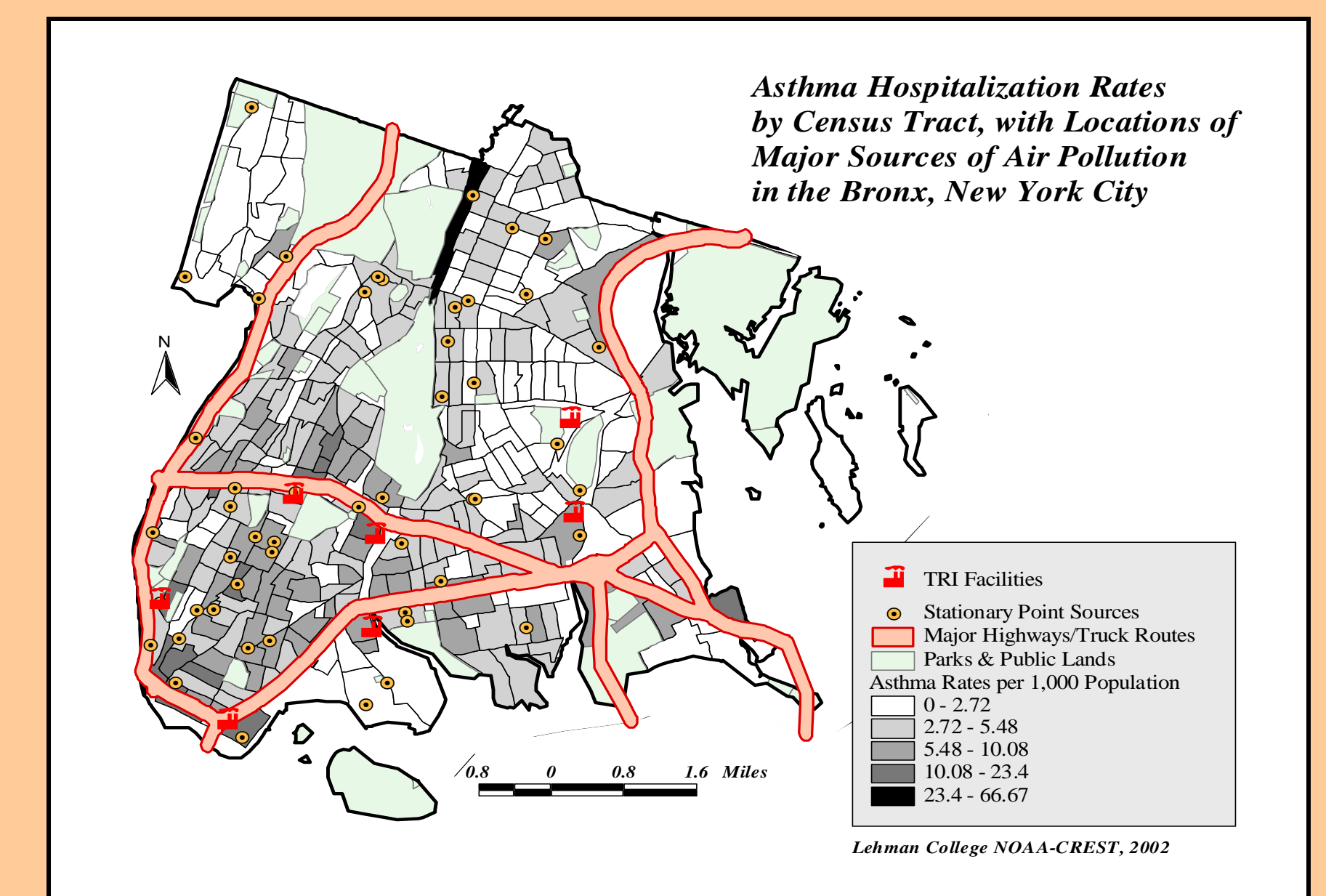
Asthma Hospitalization Rates: Interpolation by IDW (Inverse Distance Weighted), From Census Tract Centroids

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Percentage of "Minority" Residents by Census Tract, with Major Stationary Source Emissions

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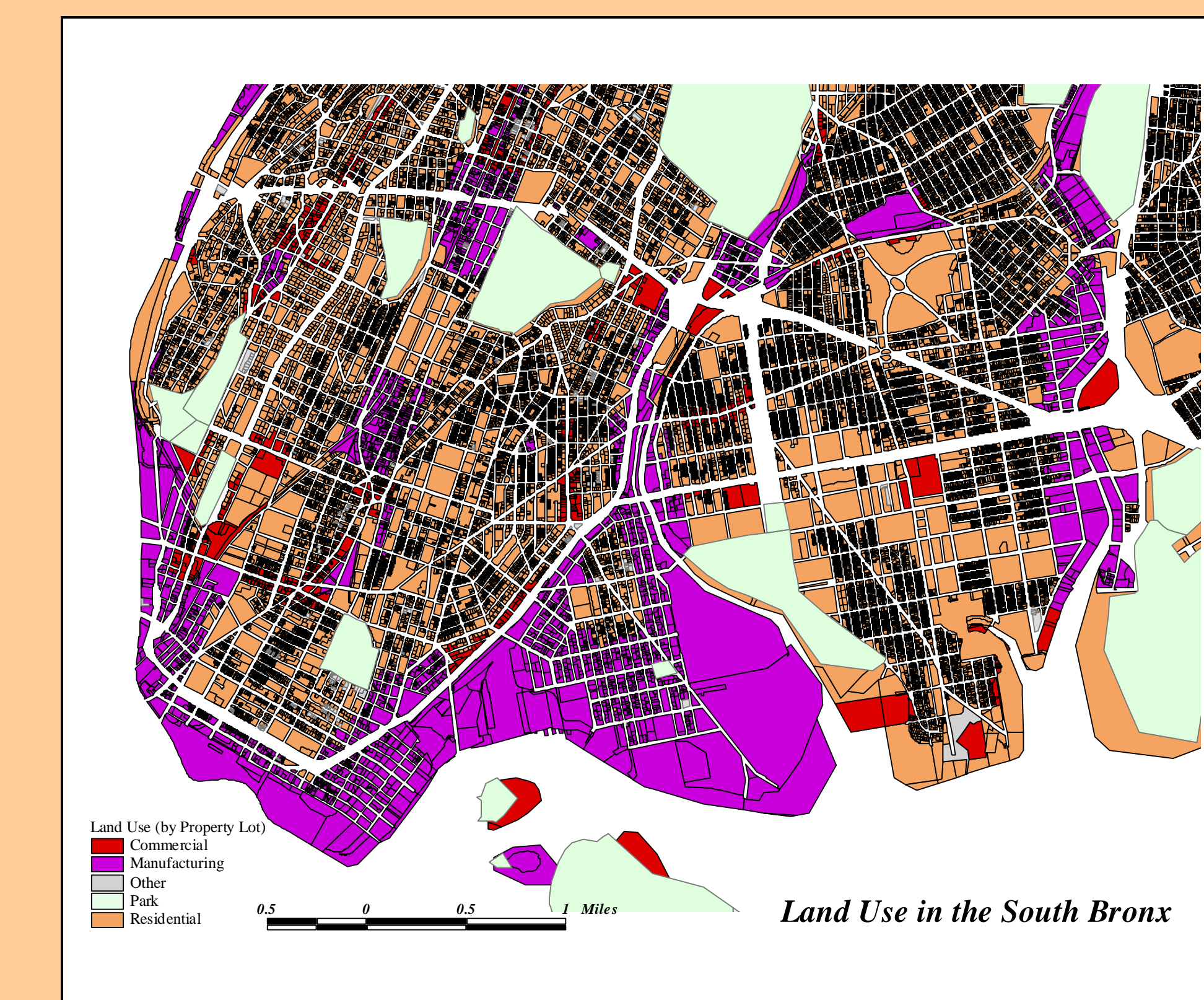
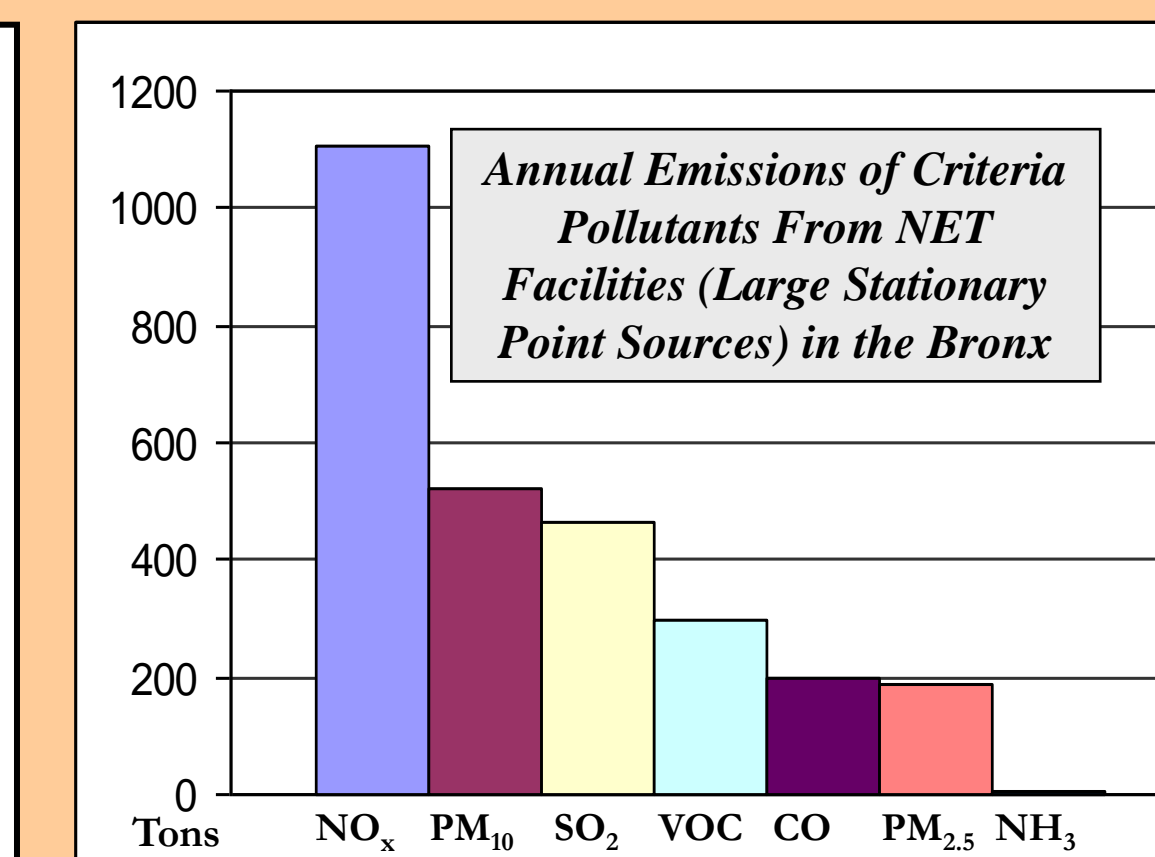
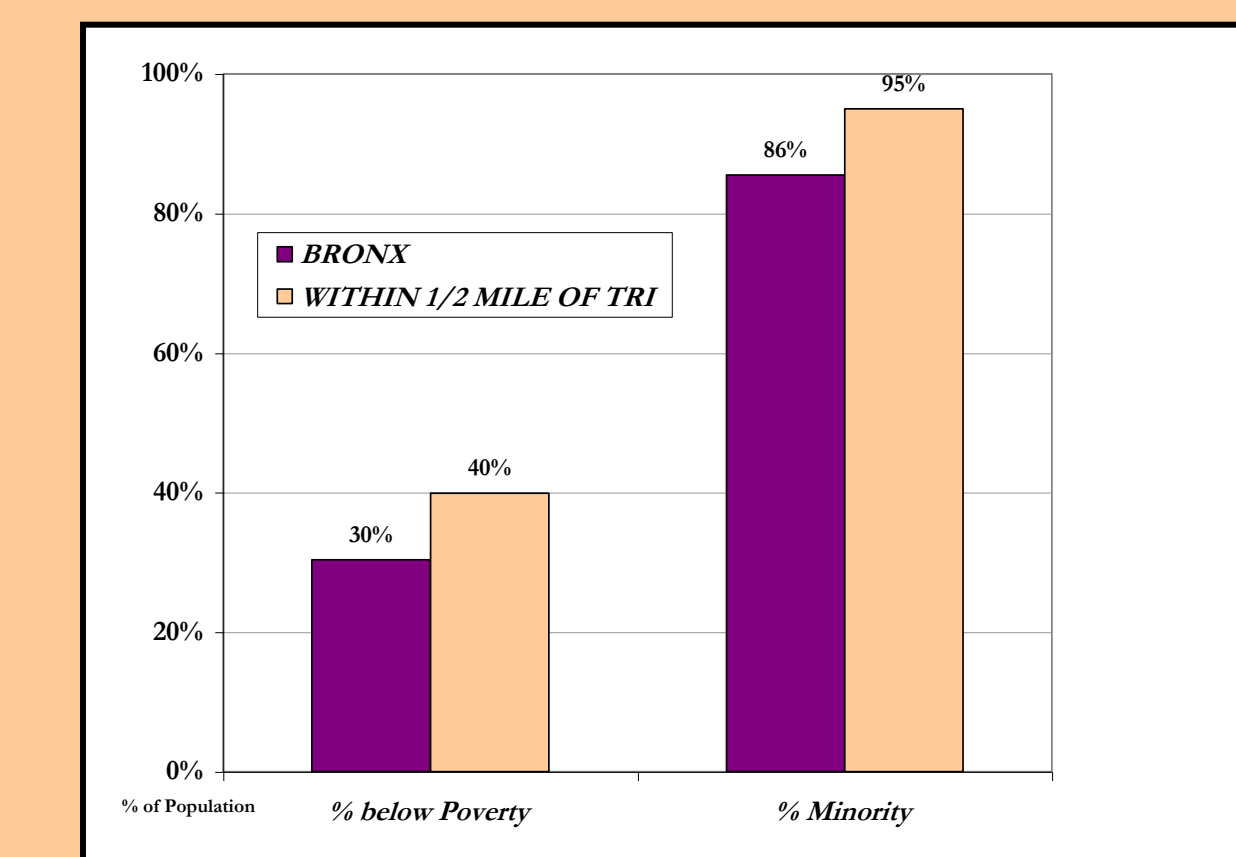


Asthma Hospitalization Rates by Census Tract, with Locations of Major Sources of Air Pollution in the Bronx, New York City

Lehman College NOAA-CREST, 2002

Methods:

- Conducted literature review on asthma research, specifically studies that examine the relationship between traffic, air pollution, and asthma incidence.
- Collected information on basic epidemiological concepts, air quality issues, methods of assessing environmental health, and current air quality models.
- Compiled a list of all federal- or state-listed facilities that are monitored by the government because of their potential to adversely affect health and the environment (e.g. TRI facilities, solid waste transfer stations, medical waste treatment sites).
- Created an attribute database containing detailed information for each facility.
- Located and mapped each facility in the Bronx.
- Created 1/2 mile buffer around TRI facilities.
- Compiled a database of all major vehicular traffic routes.
- Mapped the location of the limited access highways and truck traffic routes.
- Created 150m buffer around the limited access highways and truck traffic routes.
- Compiled a database of rates of asthma hospitalization by census tract.
- Mapped the asthma hospitalization incidence data, both as rates and as cases.
- Compiled a database of all major areas zoned for industrial land uses in the Bronx. These Manufacturing ("M") zones are legally permitted to contain noxious facilities, including those that may be individually too small in their emissions quantity to require listing with the federal or state governments.
- Using Census Bureau information, we characterized the potentially-impacted population within census tracts, by socio-economic and demographic indicators, such as race and ethnicity, and poverty status. These have been plotted as choropleth maps.
- Interpolated asthma rates, poverty levels, and percent minority from data linked to census tract centroids. These have been plotted as grid layers, and classified by standard deviation.
- Created dot density maps of asthma hospitalization cases.



Land Use in the South Bronx

Data Sources:

Geographic Information Systems (GIS) are systems that combine specialized software, hardware, spatial and non-spatial attribute databases, and the knowledge base and analytical capabilities of the GIS analyst. The main functions of a GIS are to perform spatial analyses, computerized mapping, and geostatistical operations. A map is composed of several "themes" or layers of data, which can be combined using Boolean algebra in overlay or buffer procedures to yield additional information. Data layers used in this study are listed below, along with their tabular sources and the processing techniques used to transform them into spatial data:

Data Layer: Toxic Release Inventory Facilities (TRI).
Source: U.S. Environmental Protection Agency (2000).
(TRI locations geo-coded and plotted by NOAA-CREST team, 2002)

Data Layer: Local and Through Truck Route Network.
Source: New York City Department of Transportation/Traffic Rules and Regulations (2002).
(Truck routes digitized and plotted by NOAA-CREST team, 2002)

Data Layer: National Emission Trends (NET).
Source: U.S. Environmental Protection Agency.
(Facility locations geo-coded and plotted by NOAA-CREST team)

Data Layer: Digital Orthophotos of New York City
Source: New York City Department of Environmental Protection, NYCMP (2000)

Data Layer: Major Manufacturing Zones.
Source: New York City Department of City Planning, "Citywide Industry Study: Geographical Atlas of Industrial Areas" (1993).
(Major "M" Zones digitized and plotted by NOAA-CREST team)

Data Layer: Demographic and Socio-Economic Data by Census Tract.
Source: U.S. Department of Commerce, Bureau of the Census.
"Census of Population and Housing, Summary Tape File 3a" (2000).

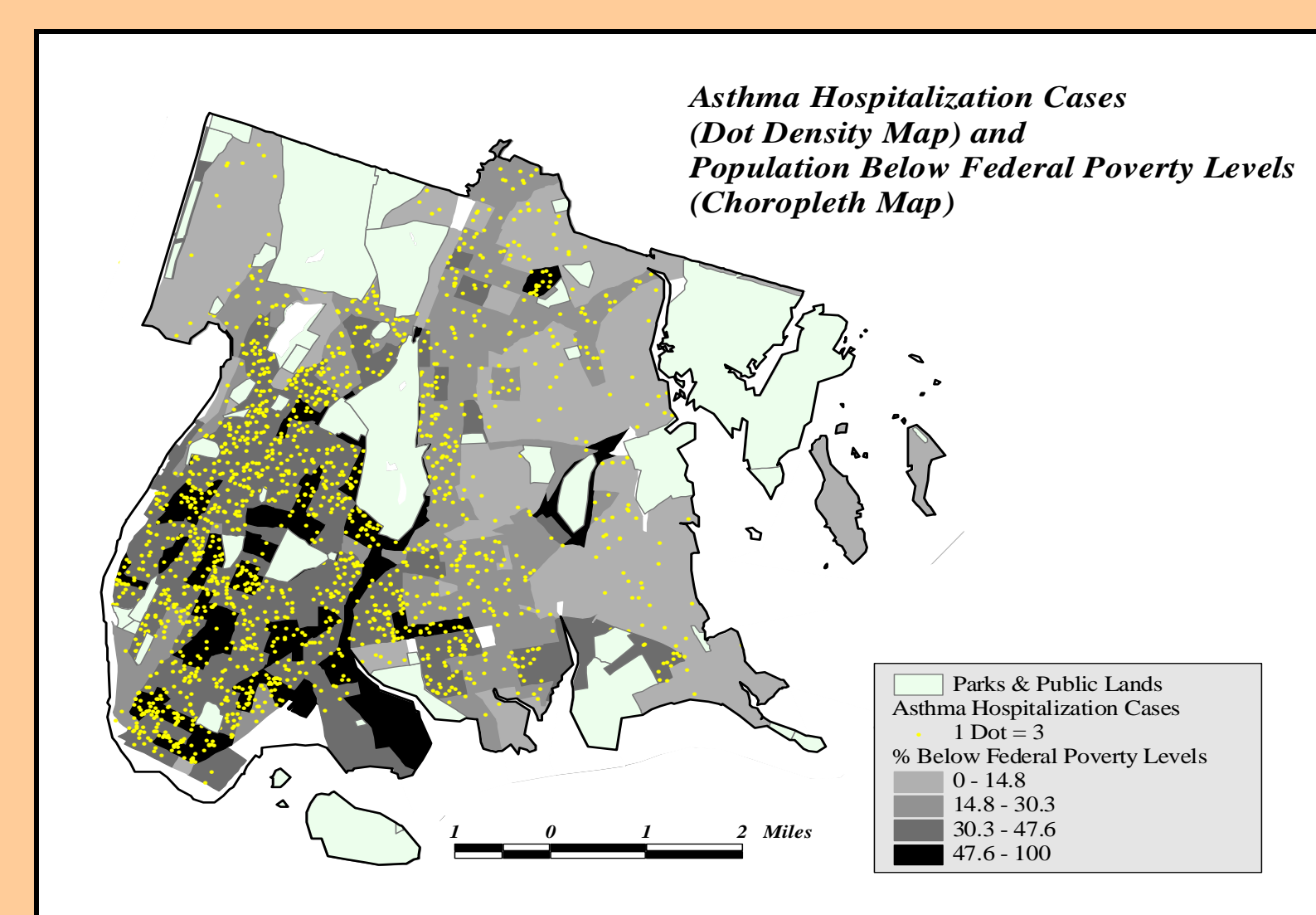
Data Layer: Street Segments
Source: U.S. Department of Commerce, Bureau of the Census (2000).
TIGER Files (Topologically Integrated Geographic Encoding and Referencing) (Limited Access Highways selected and processed by NOAA-CREST team)

Data Layer: Shorelines, Water Bodies, Parks, Census Tract Boundaries and Centroids
Source: U.S. Department of Commerce, Bureau of the Census (2000)

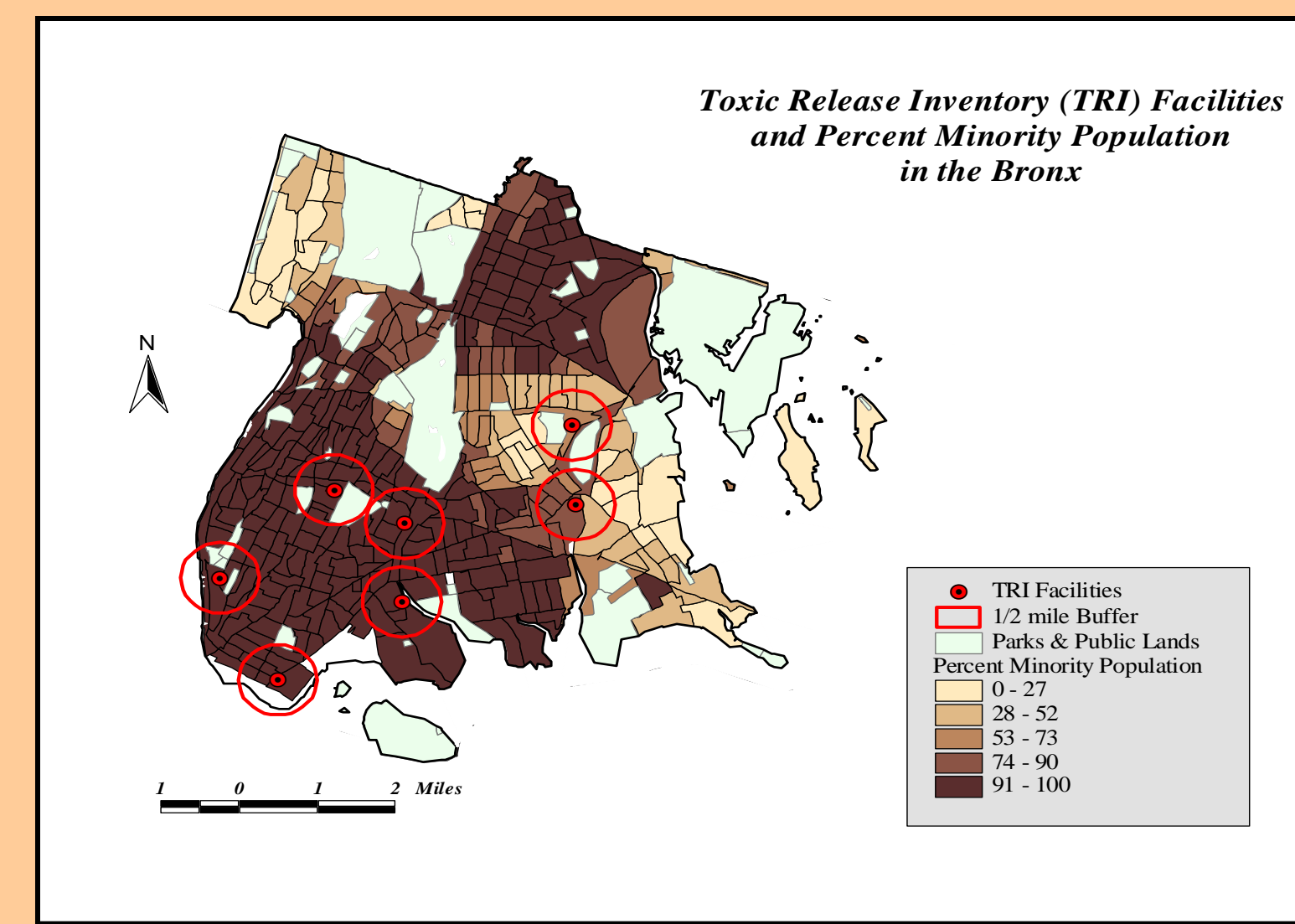
Data Layer: Permitted Waste-Related Facilities.
Sources: New York City Department of Sanitation (2000);
New York State Department of Conservation (2000).
(Facility locations geo-coded and plotted by NOAA-CREST team)

Data Layer: Zoning and Land Use
Sources: LotInfo by Space Track (2002);
New York City Department of Finance, RPAD (Real Property Attribute Data) (2002)

Data Layer: Asthma Hospitalization Data per Census Tract.
Sources: InfoShare (2000); New York City Dept. of Health, "Asthma Facts," (1999)



Asthma Hospitalization Cases (Dot Density Map) and Population Below Federal Poverty Levels (Choropleth Map)



Toxic Release Inventory (TRI) Facilities and Percent Minority Population in the Bronx

Phase One: Preliminary Findings

- Preliminary analyses suggest that there is a spatial correspondence between the rates of asthma hospitalization by census tract and the locations of environmentally hazardous land uses and activities in the Bronx.
- Our analysis suggests that proximity to hazardous land uses is also associated with areas of high concentrations of minority and low-income residents.

Phase Two: Future Steps

- Model stationary and mobile sources of air pollutants using mathematical and cartographic models (e.g. NOAA's ALOHA model) to determine more accurate estimate of impact extent.
- Model ambient air quality using EPA's air monitor data.
- Incorporate the use of remotely-sensed data, meteorological data, topographic data, air monitoring data, and geo-coded asthma patient data, to refine the analysis, and to determine if asthma hospitalization rates are correlated with air quality.

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