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Mapping Environmental Racism in New York City

Armani Ferdaous | Introduction to GIS Methods | Spring 2019

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Project Summary

Mapping Environmental Racism in New York City is a GIS-based case study that examines the prevalence of hazardous solid waste landfill facilities in predominantly low-income and racial minority-inhabited neighborhoods. This project examines the intersection of race, economics, and health in the urban landscape to reflect the planning policies that have left low-income, non-white neighborhoods environmentally degraded and ecologically hazardous.

Background

Discussions of landscape and ecology have developed primarily around theories of visual aestheticism, sustainability, and economic development as a representation of our social enterprises in advancing civilization's performance and economic output through environmental practices. The topic of race remains an overlooked issue that is omitted from the literature of environmental history and discourse. Despite the historical efforts to address ecological concerns by raising general standards, racial minorities in the United States have found themselves inhabiting neglected urban areas that have become dumping grounds for government and corporate waste disposal. This concept, known as "environmental racism" has failed to be sufficiently addressed in the frontlines of politics, resulting in the development of communities of color plagued by hazardous waste concentration, flooding, inaccessibility to potable water, and discriminatory waste management programs. Environmental racism has inarguably affected communities of color in New York City, notably in the South Bronx, which have initiated political discourse advocating for reparations and reconsiderations in site planning for hazardous facilities.

Purpose

The historic absence of inclusivity by environmentalist movements have resulted in an unequal spatial distribution of the applications addressing ecological concerns. Examining this phenomenon in New York City and its ecological effects is paramount in

addressing public health related issues such as asthma and cancer, along with urban environmental concerns such as topographic degradation, pollution, and declining air quality. This will enable urban planners and city officials to consider the future development of hazardous waste sites such as transfer stations, plants, and construction and demolition (C&D) debris collection stations and potentially provide necessary reparations or precautions for communities affected.

Literature Review

Mapping Environmental Injustices by Juliana Maantay examines how GIS has been used to map environmental injustices and the "disproportionate exposure of certain populations to environmental hazard." Maantay examines how this is a new concept that gained momentum in the 1980s, as a result of "disproportionate exposure of communities of color and the poor to pollution, and its concomitant effects on health and environment, as well as the unequal environmental protection and environmental quality provided through laws, regulations, governmental programs, enforcement, and policies." This study examines how previous GIS studies have attempted to map environmental injustices by geographically plotting facilities of "posing an environmental and human health hazard or risk, and then trying to determine the racial, ethnic, and economic characteristics of the potentially affected populations compared with a reference population."

What is beneficial from this study is the support it provides this study's hypothesis of toxic facilities being concentrated in areas with high proportions of blacks and Hispanics/Latinos. However, its limitations are that it does not provide backing for the scrutiny such maps face when met with opposition presenting findings to contradict this phenomenon with other spatial analyses. Since mapping this phenomenon is multidimensional, as it implies a racialized injustice has been perpetuated, they are left to be "open to a variety of interpretations." This source asserts that such studies "do not yield definitive findings about differential exposure levels or health outcomes for the population in proximity to the noxious facilities or

land uses." This implies an existing drawback in the correlation between the location of potential environmental burdens, exposures, and health effects and race and economics.

Urban Asthma and the Neighborhood Environment in New York City is a GIS-based study by Jason Corburn, Jeffrey Osleeb, and Michael Porter that examines the neighborhood effects on childhood asthma, giving emphasis to housing and air-related environmental hazards. The authors use the mapping capabilities of GIS to identify neighborhoods that possess considerably high concentrations of childhood asthma hospitalizations from 1997 to 2000, based on US contracts as the geographic unit of measurement. Corburn et al are concerned with the sociodemographic elements and housing characteristics that are produced as a result of air pollution from hazardous land use in these areas. Their study asserts the significance of the different factors that produce high prevalence of asthma in impoverished urban neighborhoods, such as the intertwining of air pollution resulting from the marginalizing distributions of the locations of hazardous sites, poor housing conditions in low-income neighborhoods, and the continued toxic land uses in the localities.

This literature source proved to be useful in this study as it analyzes the social and physical characteristics that affect population health on a multi-level analysis consisting of various data sets. It uses the social and physical backdrop of New York City neighborhoods to then consider socioeconomic and physical characteristics that contribute to elevated asthma incidences such as housing and environmental conditions. The study considers racial demographics, while asserting income and wealth as fundamental factors in disparities. In conclusion, it argues a positive correlation between "lower median household income, high percentage minority, public and inadequate housing, and multiple environmental pollution burdens to high rates of asthma. However, this study possesses limitations regarding hospitalization data, as it does not include individual patient information due to its focus on neighborhood characteristics. Resultantly, neighborhood characteristics observed may not apply on an entire case-by-case basis; this data also did not screen multiple

admissions of a single patient, rendering the results as number of admissions rather than asthmatic patients in a neighborhood.

Data

- NYC Census Tract Base Map Shapefile
  - "New York City Census Tracts Base Maps, 2010 Census." NYU Spatial Data Repository. Accessed April 30, 2019. https://geo.nyu.edu/.

- Solid Waste Landfill Facilities Locations Shapefile
  - “Solid Waste Landfill Facilities.” HIFLD GeoPlatform. Updated 2018

- Race and Ethnicity by Census Tracts Data
  - "American FactFinder - Search." American FactFinder - Race and Ethnicity, New York City Census Tracts. October 05, 2010. Accessed April 30, 2019.

- Median Household Income by Census Tracts Shapefile
  - Berry, Lisa. "New York City Median Household Income." Arcgis.com. May 11, 2018. Accessed April 30, 2019.

- Asthma Prevalence by NYC Neighborhood Shapefile
  - "New York City Neighborhood Health Atlas." Tableau Public. Accessed April 30, 2019.

Methodology (1-4 paragraphs)

Mapping the phenomenon of environmental racism in New York City and considering its impact on human lives entails various factors such as examining site locations, racial demographics, income and wealth distribution, and biological effects. As these elements are fundamental in examining the relationship between hazardous solid waste landfill facility locations and racial and economic inequality, this study is the result of six maps that intersect them in order to illustrate this urban phenomenon.

In beginning this study, data was researched in order to acquire information regarding the locations of solid waste landfill facilities in New York City. Such facilities range from waste handling sites such as transfer stations, treatment plants, and construction and demolition (C&D) debris collection stations among other usages. A shapefile was acquired from the Homeland Infrastructure Foundation-Level Data's open data source available to the public. Since this data was last updated in 2018, it provides the most recent set of locations depicting facilities, rendering it up-to-date for the purposes of this study. This shapefile was layered over a 2010 census tracts base map shapefile acquired from NYU's Spatial Data Repository; this provides the most recent census tract configuration. After layering the facilities onto the census tract base map, the GCS for both shapefiles were matched to be the same in order to prevent map distortion, and location points external to New York City were selected and deleted from the map. The initial map that was produced illustrated the solid waste landfill facilities throughout New York City's boroughs with no other variables, and this provided a general overview to examine spatial concentrations in particular areas.

This study considers race as the primary focus of analyzing the development of solid waste landfill facilities and the marginalization of vulnerable communities that is produced. Due to this emphasis, race-related data was researched and extracted from American FactFinder. This data originated from the American Community Survey's 2017 5-year estimates, containing estimates of racial demographic groups within each New York City census tracts. Since this data set is customizable, only white, black, and Hispanic/Latino race groups were selected. Asian race was omitted as a result of greater variance in settlement and income data, proving to be less vulnerable to the targeting of environmental racism in the urban environment. This dataset was downloaded as an Excel file to be readable in ArcMap and was spatially joined to the same census tract base map used in the initial site-specific map for overview; GCS of both were also converted to match. Three seperate maps were produced from this spatial join, illustrating white, black, and Hispanic/Latino population concentrations individually in relation to the locations of solid waste landfill facilities layered over the

maps. In each map, individual race populations were normalized over the total estimated population in each census tract. This produced classifications on each map that represented race concentrations through selected colors for each map.

With income and wealth being a secondary factor along which environmental racism is analyzed, including a visual representation of income distribution proved to be necessary. To do so, a pre-existing shapefile from ArcGis representing median income within New York City census tracts from 2010; this data was updated in 2018, enabling it to be within an appropriate time frame for comparative analysis. This shapefile was layered over the same initial census tract base map previously used in both the site location and racial demographic maps, with necessary GCS conversions performed to prevent map distortions. The solid waste landfill facility locations shapefile was then layered over this map to examine the correlation between income and wealth to hazardous solid waste landfill facility locations. The symbology was adjusted from a red to green hue in order to create a more visually readable color frame for the map to be observed by viewers.

In order to map the biological effects of environmental racism, asthma prevalence, a chronic illness politically tethered to this issue, is presented as a main indicator of ecological degradation from the hazardous land use of solid waste landfill facilities. Asthma prevalence data was acquired from NYC Health in the form of a pre-existing shapefile using 2014 statistics. This data examined asthma incidences in the adult population based on major New York City neighborhoods. After proper GCS conversions were made, the symbology was adjusted to a red hue in order to be contrasted with previous shades used in formerly discussed maps. This shapefile was layered under the location points consistently used in the previously developed maps to analyze the health implications of hazardous sites and respiratory vulnerabilities. In tracing this relationship, viewers are able to conclude the marginalizing effects of environmental racism on racial minority and low income communities in New York City.

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Findings: Maps

Map 1: Facility Locations

Hazardous Solid Waste Landfill Facilities Locations in NYC (2012)

(Source: HIFLD)

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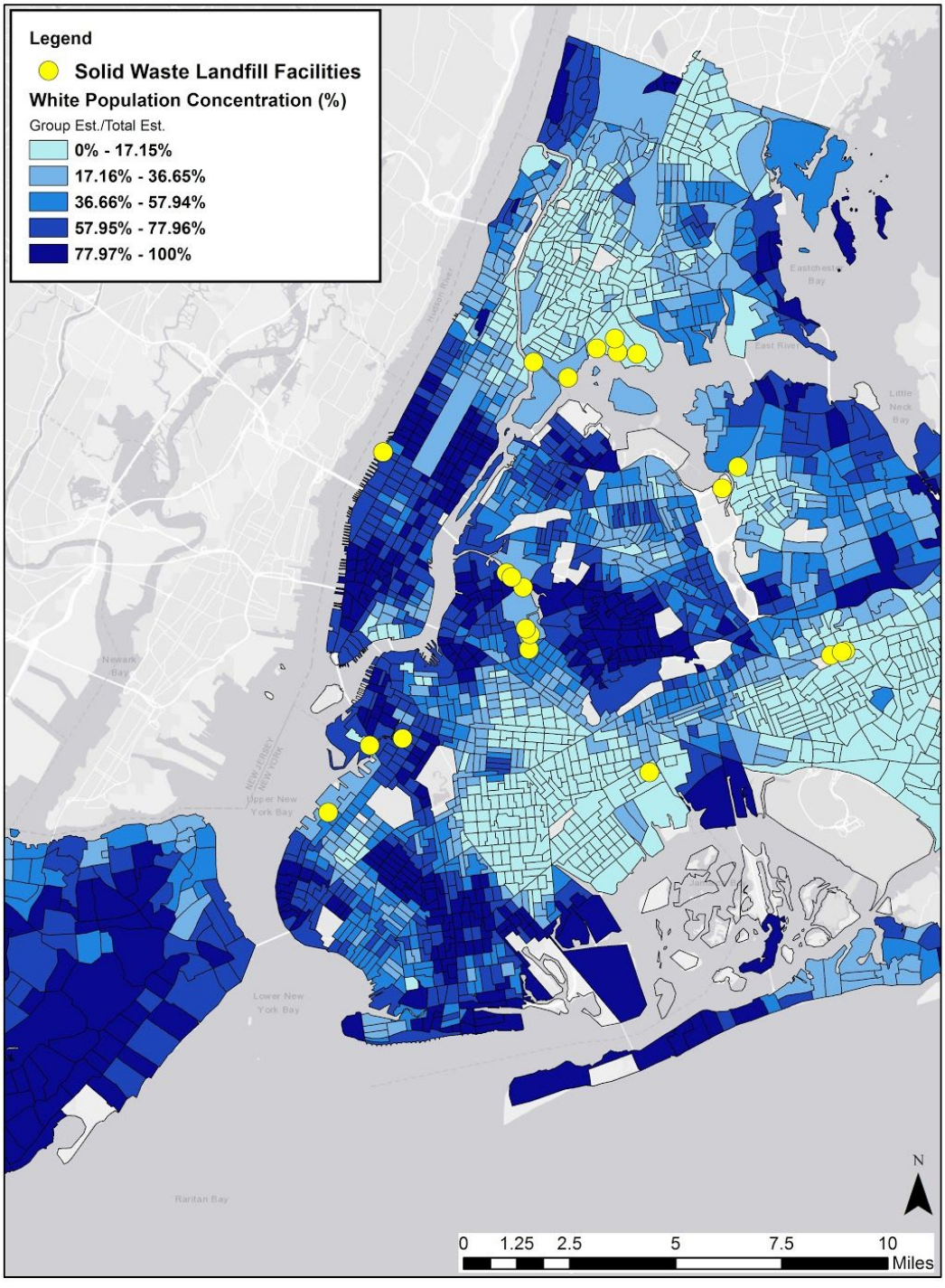
Map 2: Facility Locations in Relation to White Population Concentration

Solid Waste Landfill Facilities Locations along White Population Concentrations in NYC Census Tracts (2010)



(Source: US Census)

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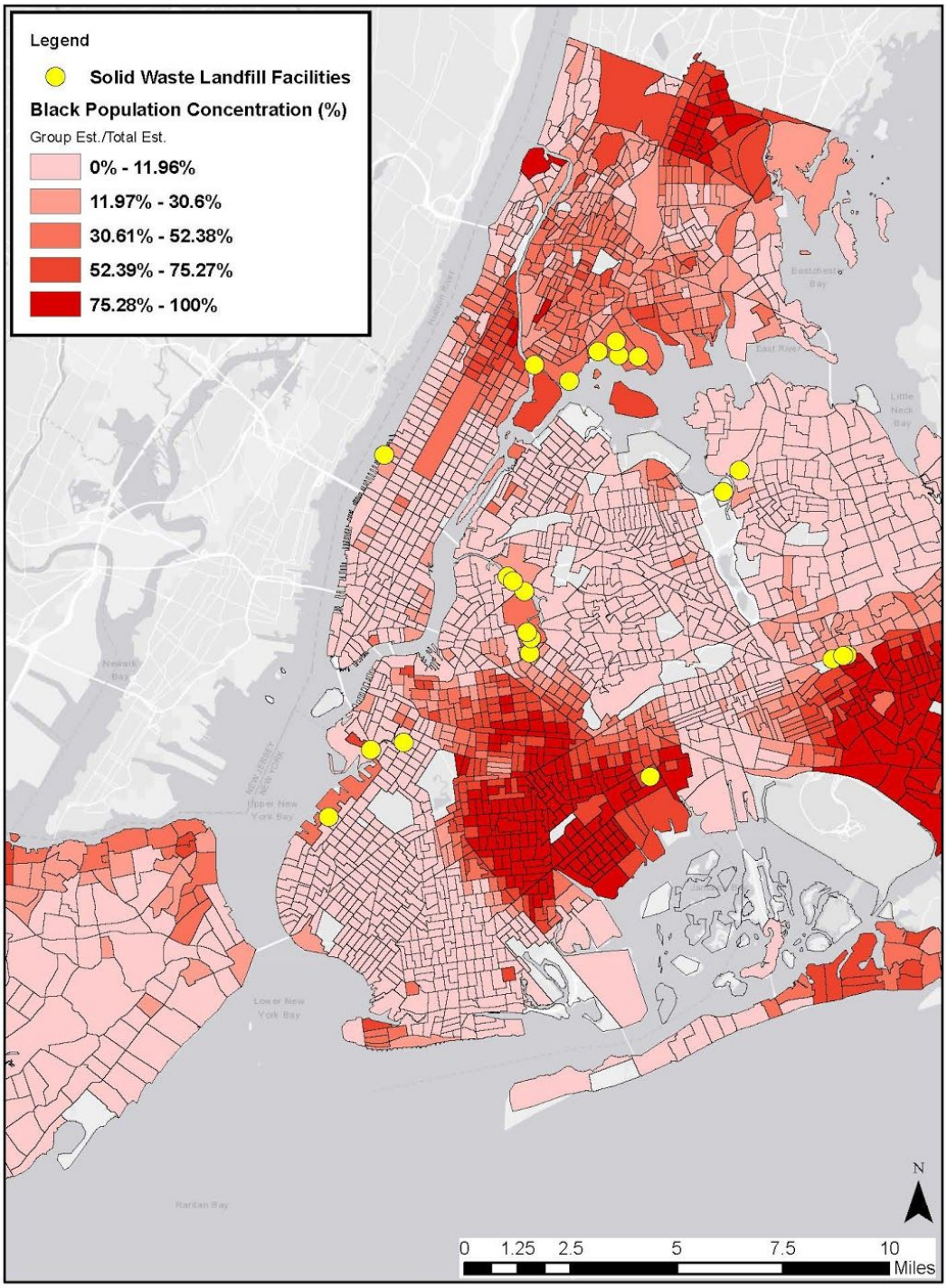
Map 3: Facility Locations in Relation to Black Population Concentrations

Solid Waste Landfill Facilities Locations along Black Population Concentrations in NYC Census Tracts (2010)



(Source: US Census)

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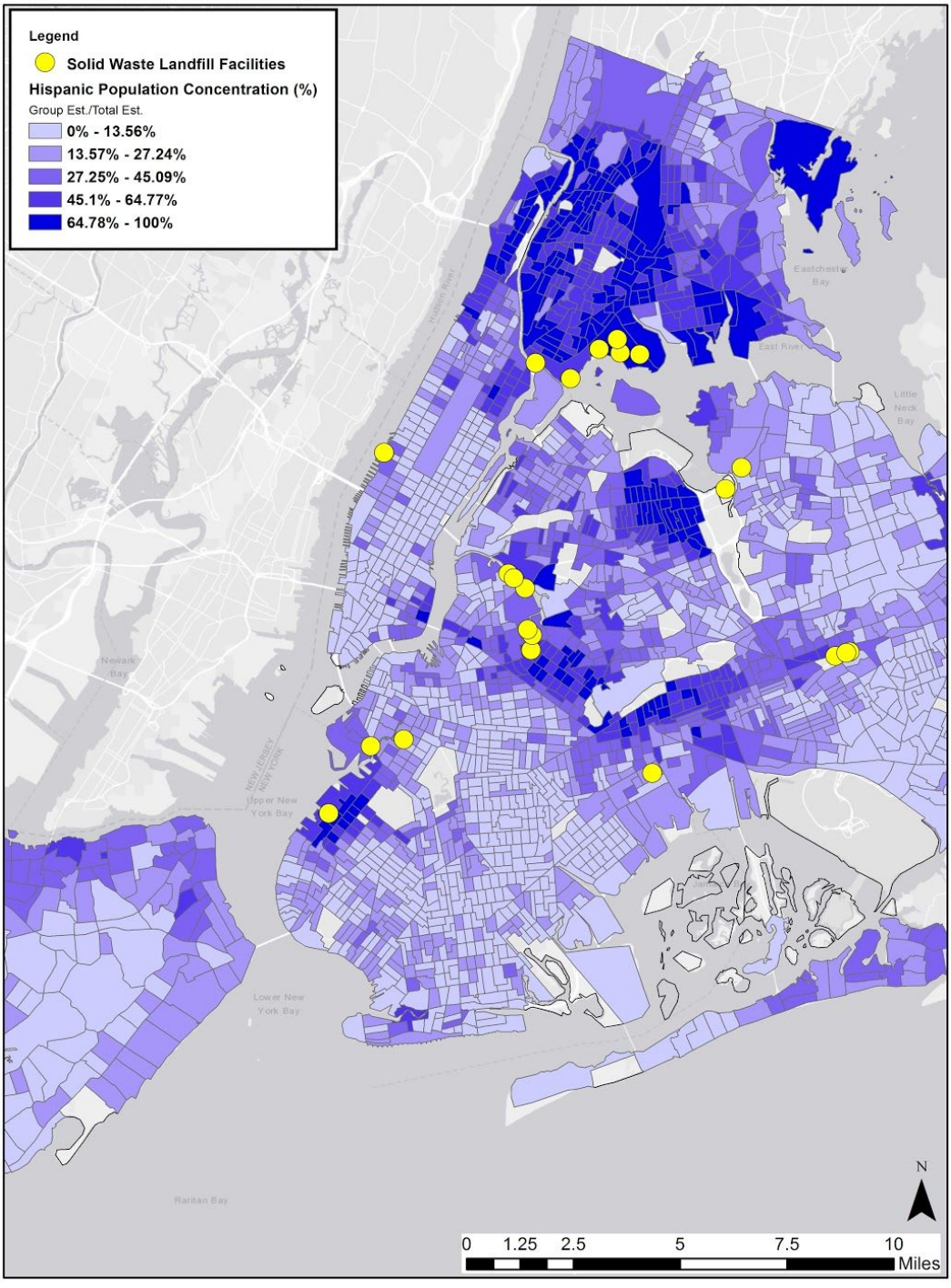
Map 4: Facility Locations in Relation to Hispanic/Latino Population Concentrations

Solid Waste Landfill Facilities Locations along Hispanic Population Concentrations in NYC Census Tracts (2010)



(Source: US Census)

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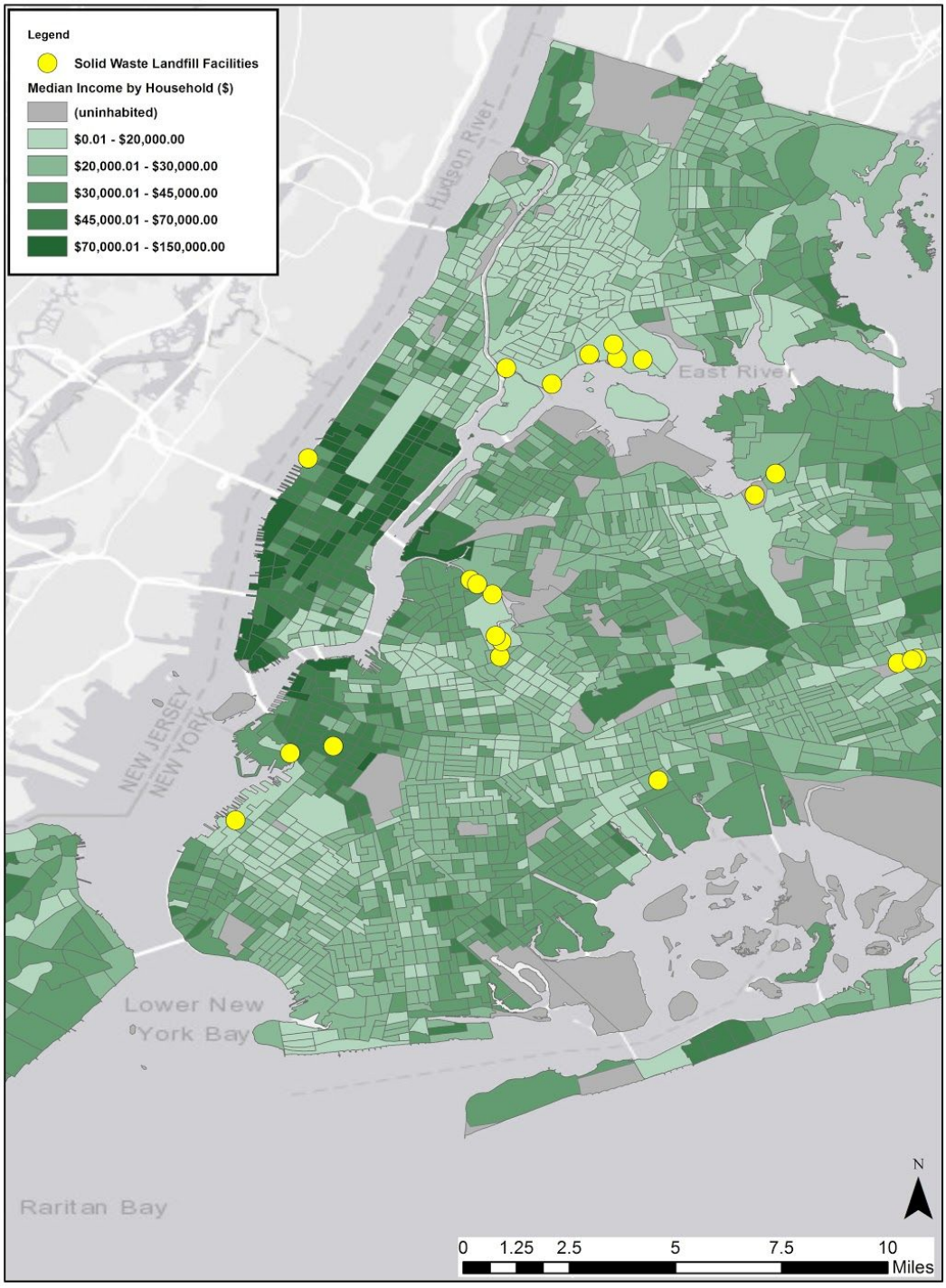
Map 5: Median Household Income by Census Tracts

Median Household Income in NYC Census Tracts (2010)



(Source: ArcGIS)

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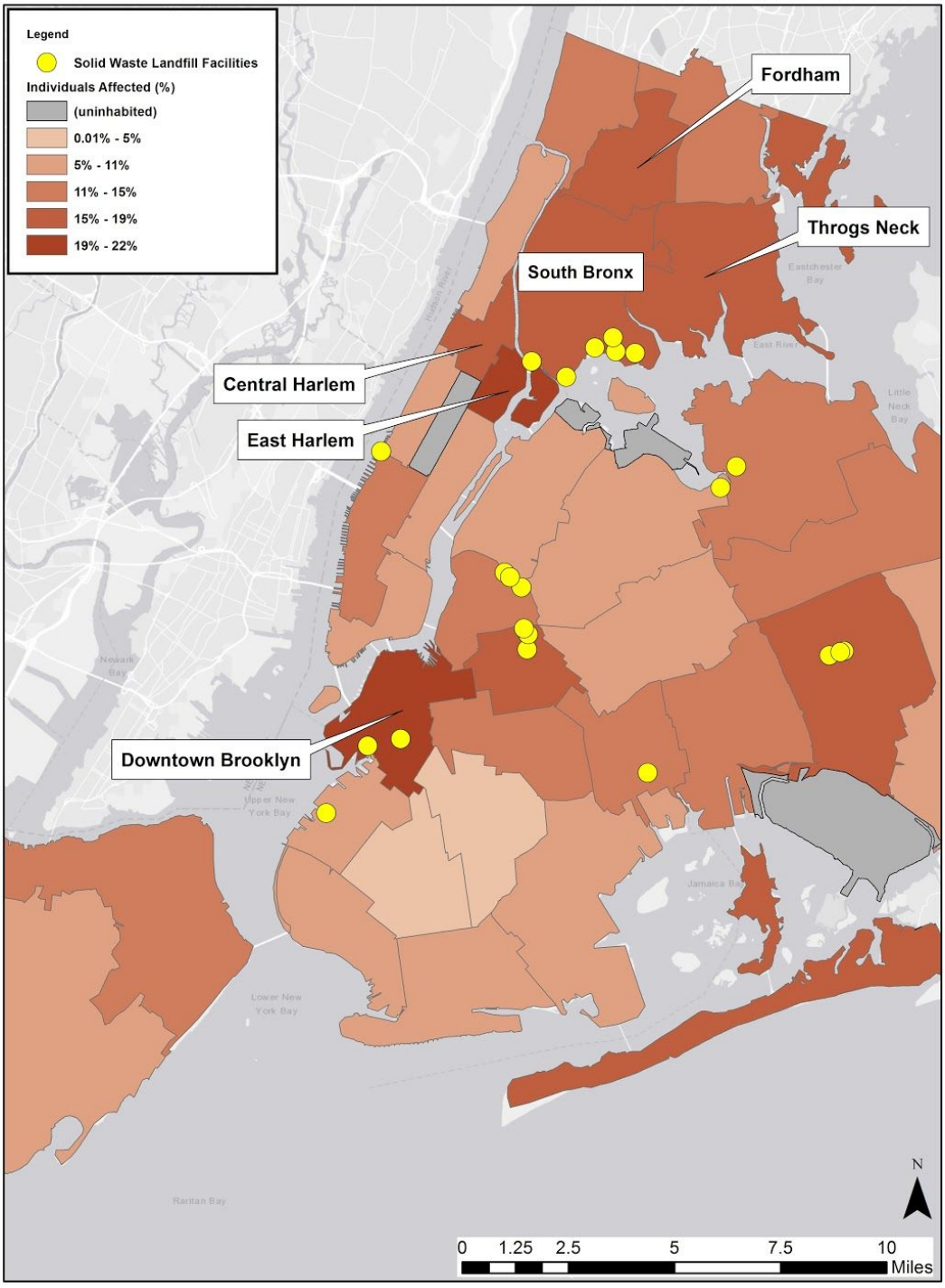
Map 6: Asthma Prevalence in Neighborhoods

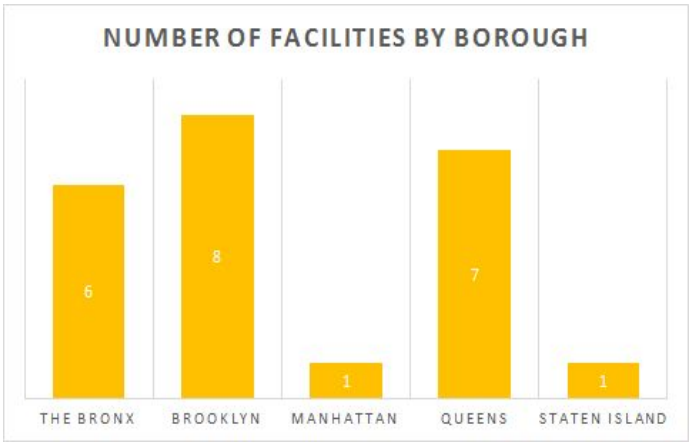
Asthma Prevalence in New York City Neighborhoods (2010)



(Source: NYC Health)

Findings: Summary

Analyzing the set of maps in this study, one can visualize the strong correlation between the locations of solid waste landfill facilities and racial and economic inequality. The maps presented illustrate the disproportionality of hazardous waste facilities located in communities of color. It is also revealed that a strong relationship exists between the location of these detrimental sites and economic inequality. Resultantly, viewers can examine one of the many biological burdens of environmental racism by perceiving the analogy between the location of facilities and high rates of asthma in neighboring areas.



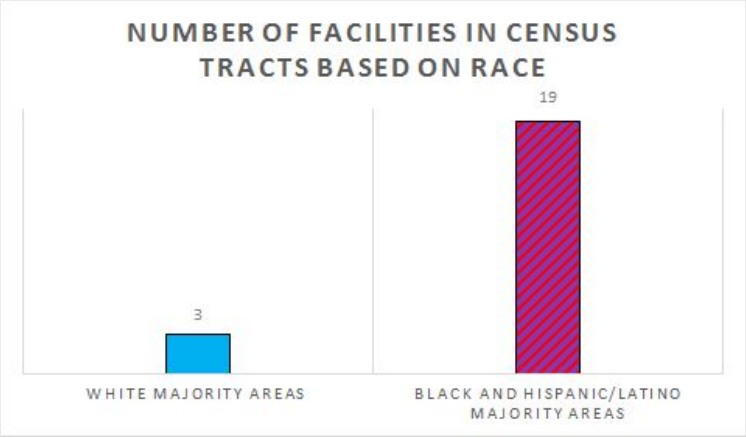
[1] Examining an overview of the locations of solid waste landfill facilities in Map 1, viewers can examine the disproportionate spread of facilities across the five boroughs in New York City, with the majority located in the Bronx, Brooklyn, and Queens. This can be due to zoning laws within Manhattan and Staten Island based on historical land use patterns or differences in land mass sizes from the aforementioned three boroughs. However, this becomes obscured as one traces the historic concentration of industrial zones on the outskirts of every borough except Manhattan, elucidating a higher concern for the city's economic center as opposed to its residential boroughs. This further brings into question the intentionality of which a wealthier class are given greater concern, as Map 5 obviates the high concentration of facilities in lower income neighborhoods. As one closely examines this map, the evidence towards this relationship is obviated as there are no facilities located in census tracts with median incomes above the overall median household income in New York City. To this regard, there are also no sites located in the top two classifications of median household incomes on Map 5. Additionally, this

[1] Excel-generated graph depicting the number of solid waste landfills (based on HIFLD data) in each borough of New York City.

relationship is further emphasized when examining the concentration of hazardous

[2] facilities in the South Bronx; here, viewers can see that the 6 locations concentrated on the edge[2] are all in the lowest income category, making less than $20,000 or less annually according to the source's data set. In fact, the majority of the sites are located in areas characterized within the bottom two classifications of median household income.

In regards to racial demographics, maps 2-4 illustrate the strong correlation between the prevalence of waste facilities and racial minority majority areas. Examining Map 2, one can observe the weak relationship between the location of facilities and white population concentrations. As the map's blue color concentrations become darker and more saturated, waste facilities are less apparent in these areas. The graph below illustrates this disparity, revealing that only 3 facilities are located in areas that consist of a white *majority.*[3] The graph also reveals that the 19 other facilities are located in census tracts that consist of racial demographics where black *and/or*



[3] Hispanic/Latino residents are *majorities.* As the the red and purple color concentrations on Map 3 and 4, respectively, become more saturated, the location of facilities become more paramount in their presence in these predominantly

[2] Close-up of Map 4 depicting the spatial concentration of solid waste landfill facilities in the South Bronx.
[3] Excel-generated graph depicting the distribution of solid waste landfill facilities between white majority areas and black and/or Hispanic/Latino majority areas.

racial minority inhabited census tracts. These maps also reveal settlement patterns along racial lines in New York City. Census tracts that are predominantly white on the first map are areas minimally inhabited by black residents on Map 3; this highlights the existing structures of social segregation that is continually present among these two racial groups in the twenty-first century. However, this residential disunion is less prevalent between white and Hispanic/Latino populations, particularly in the borough of Queens, as Map 4 reveals a greater mixing of racial demographics in these census tracts with those of white population concentrations in Map 2.

The final map in this study reveals the analogy between the location of hazardous facilities and asthma prevalence rates in New York City major neighborhoods. Map 6 observes how neighborhoods in close proximity to facilities are proven to possess higher rates of asthma incidence among adult populations, as this is the variable provided in the data set by NYC Health. While the South Bronx is frequently at the forefront of political discourse in regards to communities affected by environmental racism, Map 6 reveals that asthma incidences are most prevalent in East Harlem and Downtown Brooklyn. Nevertheless, these neighborhoods are predominantly populated by racial minorities as opposed to white population concentrations. Four out of the top seven most affected neighborhoods, however, are located in the Bronx and are characterized among the highest rates of childhood asthma in the nation. These Bronx neighborhoods, as previously noted, are in the lowest median household income categories, reflecting the intersection between race and income inequality in relation to environmental racism. The racial demographics and socioeconomic characteristics of neighborhoods in close proximity to ecologically dangerous waste facilities, with high asthma prevalence, exhibit the reality of environmental racism as a modern-day phenomenon affecting socially vulnerable communities. By examining the asthma trends of Map 6, we can see the health implications of this urban phenomenon perpetuating the marginalization of these racial and economic class groups.

Limitations

While this study has been previously reproduced in a multitude of angles, the nature of data collection and acquisition is inevitably met with time-sensitive research limitations. Among these limitations is the age of the most recent census data, as it was produced from nine years ago in 2010. This provides uncertainty regarding the extent to which the data might be skewed in comparison to this study when examining census tract boundaries. A secondary time-sensitive research limitation is the potential change in the number of hazardous solid waste landfill facilities that may have been added or removed. This data, in the form of a shapefile, also does not differentiate the type of site each point represents; it does not differentiate, for instance, whether the site is a waste transfer station of construction and demolition (C&D) debris. This distinction can provide more clarity on the health implications and environmental degradation of topography that results from their proximity to residential areas.

In regards to spatially-sensitive research limitations, racial data possessed data extraction barriers. For instance, racial data provided by the 2017 5-year estimates from the American Community Survey did not possess a "black alone" race group category. Instead, the category utilized combined black alone with "one or more races." While the demographic examined still entailed racially black-identifying individuals, it can be regarded as an offsetting factor if black alone data is only desired for research purposes. Nevertheless, the racial disparities between black and "white alone" population concentrations in regards to their vulnerability to environmental racism is still evident in the maps provided. An additional consideration, in regards to the map representations of asthma prevalence, is the limitation of scale of the New York City neighborhoods base map and its geographic unit of measurement. This base map reflects the larger definition of major neighborhoods in the city, rather than the more intricate subdivisions.

Technical limitations also affected the visualization of the maps utilized in this study. Maps 2-4, examining racial demographic concentrations, could not have their classifications adjusted to the same percentage classes in their map legends. This

resulted from the technical difficulties that arose from attempting to standardize concentration percentages among all three maps, as the result produced missing data sources or unnatural distributions. However, map legends were resized upon recommendation from their initial review to enable the data frame to be more readable for viewers, providing greater emphasis to the geography and race demographic concentrations for analysis.

Recommendations & Conclusions

This study seeks to provide visual representation to the research of environmental racism through a GIS-based analysis of urban waste facilities and the intersection of racial and economic inequality. It asserts the notion that the development of such sites containing hazardous material to human development are spatially planned and constructed in relation to low-income communities of color, exacerbating the social and economic burden imposed onto these groups. By visualizing the correlation between the spatial development of these facilities and race-related and economic-related data, a strong correlation is evident between the proximity of sites and areas characterized by racial minority inhabitants and low median household incomes. Through understanding the disparity induced by this environmental and urban phenomenon, we can comprehend the highlighted health implications of asthma prevalence in these communities which reinforce the proven hypothesis of this study. *Mapping Environmental Racism in New York City* seeks to provide rationale for the history of environmental planning practices that have targeted marginalized social groups, resulting in the environmental and biological degradation of their respective communities. Observation of this study aims to redirect the platform for environmental movements in academic and political discourse that have focused on the visual aestheticism of the urban landscape, incoherent practices of sustainability, and the emphasis on utilizing improvements in the urban environment to promote social enterprises in advancing our economic output. As these modes of discourse have failed to address the result of discriminatory planning policies developed in a

racialized context which have rendered marginalized communities subject to exploitation, environmental justice seeks to address these concerns. By examining this study, city officials and planners can address the burden faced by low-income communities of color plagued by hazardous waste concentration, flooding, inaccessibility to potable water, and discriminatory waste management programs. Simultaneously, academic discourse centered on environmental sustainability can redirect its efforts to promote inclusivity by considering the urban landscape in relation to racial and economic inequality.

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Bibliography

Corburn, Jason, Jeffrey Osleeb, and Michael Porter. "Urban Asthma and the Neighbourhood Environment in New York City." Health & Place12, no. 2 (June 2006): 121-238. Columbia University Libraries.

Maantay, Juliana. "Mapping Environmental Injustices: Pitfalls and Potential of Geographic Information Systems in Assessing Environmental Health and Equity." Environmental Health Perspectives110, no. Suppl 2 (2002): 161-71.

Yale, Aly J. "Mold, Rodents And Roaches, Oh My: NYC's Hot Spots For Asthma." Forbes. February 08, 2019.