Fall 12-10-2019

Air pollution & asthma prevalence: Hotspot analysis on environmental injustice in Buffalo, New York

Zuveria Shaguphta
zshagup1@binghamton.edu

AIR POLLUTION & ASTHMA PREVALENCE: HOTSPOT ANALYSIS ON ENVIRONMENTAL INJUSTICE IN BUFFALO NEW YORK

BY

ZUVERIA SHAGUPHTA

B.A., BINGHAMTON UNIVERSITY, 2016

THESIS

Submitted in partial fulfilment of the requirements for
The degree of Master of Science in Sustainable Communities
In the Graduate school of
Binghamton University
State University of New York
2019

Accepted in partial fulfillment of the requirements for
The degree of Master of Science in Sustainable Communities
In the Graduate School of
Binghamton University
State University of New York
2019

October 15, 2019

George Homsy PhD, AICP, Chair and Faculty Advisor
Director, Sustainable Communities Program Assistant Professor, Department of Public Administration
Binghamton University

Robert Holahan, PhD, Member
Associate Professor Department of Environmental Studies and Political Science
Binghamton University

Abstract

The effects of institutional segregation has had detrimental impacts on certain populations in the United States. African Americans and Hispanics disproportionately carry greater health burdens. A robust body of literature in epidemiology and environmental health sciences, concur that the exacerbation of asthma with the effects of impending global warming and air pollution caused by toxic producing facilities is a challenge that compels to be addressed. There are three goals of this research, in which the primary purpose of this study is to explore the formerly redlined areas created by the Home Owners Loan Corporation (HOLC) during the 1930's and the prevalence of asthma in communities today that may live in close proximity to pollution creating industries that are registered with the toxic release inventory database on the Environmental Protection Agency website. They will be referred to as TRI facilities for the remaining of this paper. Literature on environmental justice supports the idea that low socioeconomic standing individuals as well ethnic minorities such as African Americans as well as Hispanic people are more likely to live in neighborhoods that contain such unwanted industries, and therefore carry a greater burden of health disparities than Caucasian people. The second part of my analysis is to analyze red lined maps of the New Deal period, and to analyze the plausible relationship with the number

of toxic release facilities in the same regions that were red lined. Current streets and comparisons of zipcodes that were labeled as “Hazardous” from the original map were chosen as areas of study alongside areas that were deemed “Best” as comparisons. An interactive map[1] created by a collaboration of four universities, allows you to zoom in to see the current streets in the area.

This research aims to focus on the historical impacts of segregation in these communities (with Census Bureau data) and whether we see that these are the areas with continued segregation and a disproportionate number of TRI facilities. The third part of this research will be to investigate the presence of asthma in these neighborhoods as documented by the New York State Health Department. Asthma is a chronic disease in which the airways are inflamed due to some kind of external factor causing this reaction. Literature shows that there is a relationship between outdoor air pollution from combustion of fossil fuels (in particular, emissions by TRI facilities) and the onset of asthma. Although this research was taken place in New York State, there are similar patterns seen across the United States. Further research may help solve such problems that underprivileged people are facing.

Hot Spot Analysis was done using the NAD 1983 which measured in meters for the Getis Ord GI* hotspot analysis. This analysis includes several maps that were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™. An Optimized Hot Spot Analysis was the method chosen, and Global Moran fishnet grid were used. In the hotspot analysis, the northern part of Buffalo shows the highest confidence interval of 99%,

[1] Home Owners Loan Corporation (HOLC) are the original maps, “Redlined maps” created during the FDR administration. The interactive maps are created by Richmond University, University of Maryland, Virginia Tech and John Hopkins University. Nelson et al. 2019

which means that there is a statistically significant higher amounts of TRI facilities located in these ZCTAs compared to the rest of Buffalo. The bottom half of Buffalo, as seen on the map, still shows a significant concentration with the hotspot showing a 95% confidence level. Black majority zipcodes consisting of 46-80% had three out of the four zipcodes with a hotspot confidence interval of 99%. That means 75% of the zipcodes have a confidence interval of 99% higher of TRI facility siting compared to the White majority zipcodes that have a 40% of their zipcodes with the same confidence interval. The average asthma rate of the predominantly Black population zipcodes is 156-186 per 10,000. Compared to the White majority zipcodes that had an asthma rate of 56-96 per 10,000. We can clearly see a substantial difference in asthma rates between the predominantly White zipcodes and the predominantly Black zipcodes. A difference rate of 100-90 per 10,000 is here. The rate is doubled, if not more. The zipcodes with predominantly White people are, 14216, 14222, 14206, and 14210. Here we can see that the asthma rate is 71-110 and 34-71 per 10,000. These are the lowest rates shown by the map. We can see a vivid contrast with these zipcode areas and asthma rates. They are drastically on the lower end. The continuous paradigm of health and racial segregation exists nearly nine decades later.

Dedicated to my loves and to my first loves, mommy and daddy.

Acknowledgements

First and foremost, all that I am and do is because of God Almighty. This project would not have been possible without many people who supported me. I would like to thank Professor Holmes, for guiding me initial phases of this study. I would also like to thank Professor Homsy for advising me in my literature review and reading through my many drafts. Another thanks to Professor Holahan for also reading through this work. Support from the first cohort of Sustainable Communities, has not been forgotten. I also have to thank PhD student, Mohammed Rabiu Abubakari for advising me in how to go about my study when I thought I was stuck, and to Obed Varughese for helping me in how to do my spatial analysis. I also need to thank all those that supported me emotionally through this project including my husband and daughter, parents, and siblings. Dad told me not to miss this "Golden Opportunity", which is why I delved into this Masters Program. When I am at my best, I am truly my father's daughter. I am grateful for the opportunity to take classes led by professors here at Binghamton University that have sparked enthusiasm in me and to this multifaceted field of study. All of this has been made possible because of these people and helping me push through to the end. Alhumdulilah.

Table of Contents

List of Figures

List of Abbreviations

CDC- Centers for Disease Control

EPA- Environmental Protection Agency

HMDA- Home Mortgage Disclosure Act

HOLC- Home Owner Loan Corporation

SES -Socioeconomic Status

SHS- Second Hand Smoke

SIC- Standard Industrial Classification

NCRC- National Community Reinvestment Coalition

TRI – Toxic Release Inventory

ZCTA- ZIP Code Tabulation Areas

Introduction-Research Background

Asthma is a chronic (long-term) lung disease that inflames and narrows the airways. This results in asthma symptoms, including coughing, wheezing, shortness of breath, and chest tightness. Prevention of these symptoms is vitally important because if it is not controlled, it can damage the lungs. Asthma is the leading cause of chronic illness in children, according to the Centers for Disease Control. It affects about 3 million children in the United States and is increasing. Total of 7 Million people in the U.S. (CDC) There are many triggers that play a role in flare ups, and these include, pollen, air pollution, pets, insects, cold air, exercising, smoke, and stress being some of the more common triggers.

According to Perera (2017), there are certain risk factors for Asthma as well. African American, and Hispanic have higher rates of asthma. People that are raised in lower socioeconomic background are also at risk. As well as people that have frequent respiratory infections (Perera 2017). Another risk factor is being exposed to tobacco, both before and after birth. However, they can be eliminated with intervention, especially from sources of fossil fuel combustion (Spira-Cohen 2011). Among the authors, that find otherwise is Huang (2015), who says, that poor SES has actually been shown with lower occurrences of allergic diseases, and those that have higher SES in combination with higher educational levels and higher family income have shown

greater occurrences. The hygiene hypothesis fundamentally means that highly controlled environments that are "too clean" can cause humans to have an immune system that is too weak to handle any kind of stress. Therefore, the body reacts to foreign microbial invasion by defending itself, and takes the next step by flaring up the airways, this in turn, causes asthmatic symptoms (Ramos 2006).

As briefly mentioned, this paper will aim to focus on Buffalo, New York as the study area. The original maps of the HOLC (redlined maps) and the documents of the 1930's that were also created by the HOLC, have been important because they give us demographic information that has been vital to this study. These documents give us the estimates of the number of minorities that were living in certain sections of the city. Minorities were designated to live in certain regions that are clearly defined and separated from the affluent population. The documents also show us the number of homeowners in the region. This is important because it gives us more information about how many minorities were able to afford homes in the redlined areas. Further along, in this paper, a brief history of Buffalo, New York will also give us perspective on African American migration settlement, (One of the first groups of minorities) in this city. The United States Census data (2010) shows us African American and Hispanic continue to live in those areas. A spatial analysis with ArcMaps[2] displays the locations of the toxic release inventory facilities. The last part of this exploration will be to look at New York State Dept. of Health data on asthma rates of emergency hospital visits in the selected areas. Since data on health is not readily available to the public due to privacy concerns,

[2] ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.

I was able to look at asthma rates at the zipcode level. This is the smallest geographical area with health data available for the public.

Chapter 1. Relationships between Asthma, Socioeconomic background and Proximity to toxic facilities

1.1. Relationship between socioeconomic background and proximity to facilities

The following portion is a literature review, giving us insight into the relationship between socioeconomic status and how this affects communities, and their tendencies to live near toxic facilities in the United States. African American and Hispanic people and people living in poverty are more likely to live near undesirable land uses such as landfills and polluting facilities (Weinberg 1998, Pulido 2000, Krieg 2005, Perera 2017). One important question although asked in an older study and continues to be relevant is, "How does it come to be that some social groups become disproportionately exposed to toxic wastes?'' Weinberg (1998 p. 25). Perlin (1995) would agree with Weinberg, and says that ethnic groups including Blacks, Asians/Pacific Islanders, other races and Hispanics, compared to Whites, are more likely to live in such areas (Forno and Celedon 2009, Sacoby 2012, and Perera 2017).

Research have supported the idea that minorities carry a greater burden of dwelling near disamenities (Campbell 2010, Burke 1993, Faber and Krieg 2002, Ringquist 2005, Outka 2017). The lack of political capacity hinders the community's

growth by keeping them in unlivable conditions. It is as relevant today as it was before, but Cutter's work shows the same paradigm today. Cutter (2012, p. 162) has said, "Without capital or power. Poor people who live on marginal lands, eventually get displaced by them. The observed patterns between air pollution and demographics today are in part a persistent legacy of past segregation." This section not only focuses on race, but also how economic standing plays a part in neighborhoods with greater amounts of toxic release inventory facilities.

Some authors have found that race is not the sole factor, when it comes to perceived quality of a neighborhood. Class of residents plays a role in the value of housing, where price has declined with the increase of Black people residing in neighborhoods (Pettigrew 1973, Harris 1999 and Taylor 2014). Literature also shows that African Americans and Hispanics do not earn the same amount of money. In Pew Research by Patten (2016), "Large racial and gender wage gaps in the U.S. remain…Among full- and part-time workers in the U.S., Blacks in 2015 earned just 75% as much as Whites in median hourly earnings and women earned 83% as much as men." In essence, this further creates equality gaps between the different races.

A substantial amount of literature has been written on the division that has separated poor communities, and giving them little choice but to live near disamenities. The following are examples taken from case studies of how minority neighborhoods are impacted by pollution.

Examples of how minority neighborhoods are impacted by pollution

Phoenix Study

The impacts of segregation have had a consequence on the demographics of regions. In Phoenix, Arizona, Pope et al. (2016 p. 753) has found that "African Americans and Hispanic people, arriving after the nineteenth century Anglo settlers, were excluded from living in privileged areas reserved for Whites, including by restrictive deeds and covenants, and instead were segregated into South and West Phoenix, where city planners placed heavy industries and waste handling facilities".

Buffalo Study

"An analysis of toxic release inventories (TRI) and U.S. Environmental Protection Agency (EPA)-regulated facilities in Buffalo, NY, fails to show evidence of environmental racism. The absence of environmental racism can be understood as the product of historical residential and labor-market segregation that excluded African Americans from residing in industrialized sections of the city". (Krieg 2005)

Study in St. Louis Missouri

"The analysis of TRIs across metropolitan St. Louis shows that minority and low-income residents were disproportionately closer to industrial pollution sources at nonrandom significance levels"(Abel 2008). Literature on discriminatory siting also are controversial. As mentioned by Abel 2008, Vicki Been (1994) Study of landfills in the 1970's, found that "housing discrimination and poverty led to environmental inequities instead of discriminatory siting."

Study in Bronx, NY

Maantay (2007) found in this study, "Of the five boroughs of New York City, the Bronx is the least affluent, having the lowest mean household income, and the highest

percentage of people below the federal poverty levels. The Bronx contains the highest percentage of minority population (85.5 percent)". Industrial zoning was placed in the Bronx, "In the 1970s through the 1990s, while other areas of New York City were gentrifying and city planners were changing industrial zones into areas zoned for residential and commercial uses, the Bronx had large swaths of residential land re-zoned for industrial, and had existing industrial land re-zoned for heavier industrial uses (Maantay, 2002b). By decreasing the extent of industrial zones in the rest of the city and increasing those in the Bronx, the historical zoning change process has virtually assured that industrial areas in the Bronx are the proposed home of many new noxious facilities." Maantay (2002) and (2007) studies are just as relevant today. From this, we can understand why socioeconomic status has played a role in how the poor and minorities were and continue to lag behind, while other communities and neighborhoods prosper, socially and economically.

Study in Baltimore, Maryland

Taylor (2014 p. 155) "Southern cities explored zoning as a form of land-use regulation and as a mechanism to facilitate residential segregation simultaneously...imposing racial order." According to Taylor, Black people during the Jim Crow era, and decades following were "not allowed to move onto a street where half of the residents were White, and vice versa".

Study in Charleston, S.C.,

As noted in many studies, people of color and poor populations exposed to environmental hazards show increased health risks that are heavily influenced by many

social factors, including “racism and classism, segregation, socioeconomic status (SES), and inequities in zoning and planning” (Wilson 2012 p. 102). This study has also been relevant to this literature review because it also supports the same patterns of how housing discrimination in respects to zoning has led to segregation. This research has shown that are cases of unhealthy land uses.

These examples that have been derived from case studies, all have one thing in common, they show that African American people as well as Hispanic people have been pushed to live near disamenities including hazardous waste sites and polluting industries and therefore carry a greater health risk burden. One conclusion we can make here has been mentioned above, the impacts of segregation has had detrimental consequences amongst minorities.

Segregation and race has been studied by William et al. (2012). There are certain “mechanisms” when it comes to the relationship of segregation and health. This work gives a thorough understanding of this topic in literature. William et al. (2012) describe how these two factors are related to one another. Among these mechanisms they state, Discrimination and socioeconomic status is one of them. Racial composition has been a primary driver in the decision-making process for corporations when it comes to locations of their facilities. There are many other factors that are associated with socioeconomic characteristics of African Americans, and William et al. (2012) say that this group experiences greater amounts of job-loss, this further creates disadvantages to this group of people.

The second of the mechanisms the authors here say is neighborhood quality. Amongst neighborhood quality amenities, walkability, access to healthy foods, and

healthcare are included. William et al. say, scarcity of grocery foods in such neighborhoods may also contribute to unhealthy eating. Other factors such as parks and green spaces may be limited in such places. Exposure to indoor allergens, exposure to second-hand smoke are some chemical pollutants that segregated communities face, that contribute to poor health. Many homes may also be in deteriorating qualities.

The third mechanism William et al. (2012) look at is segregation and medical care. Access to quality health care is highly important for good health status. The authors say that often times segregated communities receive poor treatment interventions, compared to their White counterparts. This may even well include ambulatory care and health promoting programs. Furthermore, they may not receive the adequate medications. This is highly important when it comes reducing asthma attacks and coping with asthma symptoms. As well as "documented asthma management plans" from inner city hospitals and community health care centers.

The last of these "mechanisms" that the authors are talking about is "collective efficacy". Segregated neighborhoods may lack social and communal resources. When formal community resources are not present, many African American communities will rely on informal networks "to meet their needs". They say that informal networks may cause harm instead of doing good, just because there is a lack of regulation, supervision and professional/governmental oversight.

The mechanisms that William et al. (2012) have provided are coherent with this paper as this paper focuses on the topics of segregation and what makes matters worse for segregated communities. Neighborhood quality such as green spaces, walkability, access to healthcare, neighborhoods that are crime-free, access to nutritious food,

political voice, resources for educational institutions and their constituents and other social support services, are highly beneficial for making a sound neighborhood and one that flourishes. Clean water and clean air are basic fundamental rights that every human being should have.

1.1.1 Studies That Support the Prevalence of Asthma in Segregated Neighborhoods

One definition of residential segregation is the, "degree to which groups of people categorized on a variety of scales (race, ethnicity, income) occupy different space within urban areas, and the process that creates this differential spatial distribution" Massey and Denton (1988 p. 179). Keeping this definition in mind, we can see why this factor plays a role in environmental quality and ultimately healthy neighborhoods. Williams et al. (2012) suggest that racial disparities in health have a direct relationship with residential segregation . This segregation sorts people into social and economic environments according to their race and class. This work has contributed to pertinent information about how health disparities, and in particular, how asthma and segregation have an impact on each other.

Among other authors that supports this idea are Pacheco et al. (2014),"Housing has long been a marker of socioeconomic status and has been, in the United States, a mechanism for segregating communities based on income and race. This has produced concentrated poverty and perpetuated the downward spiral of housing conditions and community infrastructure in certain areas of nearly all cities". (Pacheco et al. 2014 p. 467) It is interesting to note that these authors have used the term "downward spiral",

because segregation has led to other ill effects on the community's well-being, including health.

In their research conducted in New Jersey 2018, Alexander and Currie (2018) have reported that low-income neighborhoods, especially poor African-American neighborhoods have higher rates of asthma. Their research also focused attention on low-birth weight children in these segregated neighborhoods. Place of residence has been distinguished as the factor relating to higher rates of asthma amongst children in the study conducted by Alexander and Currie (2018). These authors support the idea that segregation has brought negative consequences.

Two very important notes that Kramer and Hogue (2009, p. 178) point out is that "The Black-White urban residential segregation seen today is distinct from any other ethnic or group segregation in the United States, and perhaps elsewhere in the world, and therefore reflects a process of social stratification that is both historically situated and uniquely American." This statement has brought forward other key questions, how are these segregated urban areas unique to this country alone? What makes them unique, because segregation takes place all over the world, with the underprivileged. The other important piece of information when it comes to health disparities and segregation that these two authors say is that, since there are different mechanisms that caused segregation for the African American populations, there has been varied health implications over time. These authors looked at how segregation ensued through many phases of history such as the formation of ghettos and enclaves, the expansion of these ghettos and also segregation that ensued before the Fair Housing Act of 1968, and the health disparities that followed suit. From their work we can conclude that when we

study the African American history of housing and segregation, we will see how segregation has played a major role in the social mobility and health implications of these people.

In this work, Beyer et. Al link racism, segregation and chronic disease outcomes. Although Beyer et al. (2016) has focused attention on the presence of Breast Cancer amongst African American women populations, (and ultimately the focus is health disparities, when it comes to chronic illnesses) proximity to toxic release inventory factories (and hence exposure) is a environmental justice issue because there tend to be greater incidences of asthma amongst these neighborhoods.

We may ask the latter, if the opposite relationship can be true. There are some studies however that say that segregation may be related to healthier communities. Herbst and Lucio (2016) have stated, "residential segregation actually buffers the deleterious health effects of regional disadvantage". In particular, the authors find that the relationship between income inequality and mortality is "mediated by the high levels of "social cohesion" that exist in segregated Black communities" mentioned here by Herbst and Lucio (2016 p. 6). To avoid racial tension in heterogeneous communities, being close to public transportation, location conveniency for occupation and closer to family are some of the many reasons that segregation can be seen as beneficial (Trudeau 2006, Nuru-Jeter and LaVeiste, 2011). Some research suggest that segregation can benefit the White populated communities. "Racial residential segregation may benefit Whites economically, politically, and culturally via several key pathways: by removing them from residential areas of concentrated disadvantage, by distancing them from criminogenic subcultures and areas of higher victimization, and by maintaining political

stability and/or reinvestment in White Neighborhoods" (Beaulieu and Continelli 2011 p. 487). Although unpopular, and controversial, this disagreement with the mainstream thought, that segregation has beneficial health outcomes may need to be studied more.

To sum up this section, we can see that literature has shown that African Americans and Hispanics live in closer distances to toxic facilities. To further this idea, authors also found that minorities are more likely to live near disamenities. Other literature has found that these groups of people are more likely to have low political power. In this section, I have also discussed the discussion of low class residents being part of this mix. The other main part of this section was to reinforce literature that has focused on segregation and prevalence of asthma. The relationship of segregation and health burdens does exist.

1.2. Relationship between proximity of TRI Facilities and Asthma

What area TRI Facilities and How accurate are they to use in Research?

According to the Environmental Protection Agency, the Emergency Planning and Community Right-to-Know Act (EPCRA) section 313 created the Toxic Release Inventory (TRI) Program. They have also stated, " TRI tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and/or managed through recycling, energy recovery and treatment." This program was created because of a tragic accident that

involved a chemical plant in 1984, in Bhopal, India. As reported on their site, This incident claimed thousands of lives in one night, and continued to affect many more due to the exposure of chemicals. The following year in West Virginia, there was a similar occurrence at a chemical plant. Some may wonder about the accuracy of the program. According to the EPA website, TRI data is reported annually and is taken directly from the facilities. It is mandatory for facilities to report the relevant chemicals.

The EPA website also states, “In general, chemicals covered by the TRI Program are those that cause: Cancer or other chronic human health effects, Significant adverse acute human health effects, Significant adverse environmental effects. There are currently over 650 chemicals covered by the TRI Program. Facilities that manufacture, process or otherwise use these chemicals in amounts above established levels must submit annual TRI reports on each chemical. The TRI chemical list doesn't include all toxic chemicals used in the U.S.” This fact provided by the EPA website, may be a red flag for concern. For this reason, in this paper I will discuss which chemicals have impacts on the respiratory system, and which ones have been mentioned to be important for avoidance.

Besides the TRI program, there are many other programs that the EPA collects information from including the NEI, RCRA, PCS, RMP. . As stated on their website, “A number of EPA programs collect chemical release and waste management information. Each of these programs has different requirements for who must report, what information must be reported and how often they must report. There is, however, some overlap between the facilities regulated by these programs and the facilities that report to TRI. Users who want to find information that is not available in TRI can check the

databases associated with these other programs. For example, the National Emissions Inventory (NEI) can be used to find estimates of air releases for facilities that do not report to TRI or for mobile sources such as cars, which are not covered by TRI.

The public also has power to petition for more chemicals listed on their database. Under EPCRA Section 313, the public can petition EPA to add chemicals to or delete chemicals from the TRI list. We may ask what measures are taken by the EPA, for ridding chemicals and limiting exposure. Ranson (2015) has mentioned in their study the practice of Source reduction. As stated on the website, Source reduction, as defined by the U.S. Pollution Prevention Act of 1990, is any practice that "reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal". Source reduction is a widespread practice: between 1991 and 2012, the industrial facilities that reported to the U.S. Environmental Protection Agency's (EPA's) Toxics Release Inventory (TRI) program carried out 370 000 source reduction projects. Source reduction prevented approximately 4.8 to 14.4 billion pounds of toxic releases between 1991 and 2012, corresponding to a 9–24% reduction (Ranson 2015 p. 49). Although the EPA has provided public viewable data, there are problems when it comes to using the data provided and how accurate it can be. Let us review some shortcomings in this next section.

1.2.1 Differing views on Accuracy of TRI data

Literature that has focused on TRI data have agreed that it is collected for regulatory purposes and not for exposure assessment so it is not a great tool for measuring exposure (Perlin 1995, Fortunato 2011, Abel 2008). To make matters more confusing, the EPA frequently changes the reporting requirements in what chemicals need to be reported and the maximum capacity of emissions released. Other limitations when it comes to using Toxic Release Inventory data is mentioned by Abel (2008 p. 247) "First, TRI data are self-reported, and EPA lacks sufficient resources to extensively audit facility reports. Second, the EPA reports the widespread use of release estimates rather than monitored data. Facility estimates may therefore fall well below or above actual release amounts. However, no other reliable database of pollution releases currently exists, making alternative risk evaluations impossible." Understanding the shortcomings of using TRI data provided, allows us to be critical about what research comes from using this source, and skeptical of outcomes.

Furthermore, it is important to look at TRI data through a time-series as opposed to just a snapshot and to focus on emissions with an emphasis on pollutant concentration instead of facility location, (Perlin 1995, Sacoby et al. 2012) . In addition, other studies have used Risk Screening Environmental Indicators (RSEI) and National-Scale Air Toxics Assessment (NATA) data instead of TRI facility location and emissions data to

better represent the toxic potential of local emissions. Researchers have found that it may be a better measure of burden for populations who live near TRI facilities. Among those that are in less favor of the TRI data are Dolinoy and Miranda (2004, p. 112), who have also listed their opinions on TRI data,

"The TRI program suffers from at least three weaknesses. First, minimum reporting requirements do not require smaller industrial facilities to report. Theoretically, cumulative effects of smaller non-TRI-reporting facilities might outweigh the individual effect of larger (but fewer) TRI reporting facilities. Second, the U.S. EPA's TRI database (as well as TRI data organized and maintained by environmental interest groups) does not address environmental fate and transport of industry emissions using modeling and other analytical techniques. The characteristics of pollutant concentration distributions depend on a variety of factors, including media emitted, physical properties of the chemical, wind direction and speed, meteorologic conditions, and stack height. Finally, by reporting emissions at the county level, the TRI database fails to capture important highly localized equity impacts."

It is interesting to note that toxic release inventory facilities must report their emissions only if they are a certain facility size. This may not work in favor to those that live near smaller facilities and face the health burden by the polluting causing facility, no matter what size it may be. It is important to consider wind direction, meteorological conditions and their effects on air quality Dolinoy and Miranda (2004). This portion of the literature review has been vital in understanding the unintended consequences of using TRI data as a tool in studying health data.

1.2.2 How does exposure cause sickness?

No literature on health is complete without the explanation of the relationships between exposure and disease outcomes. Burger and Gochfield (2011) have said that it is harder to find data on exposure when it comes to environmental health disparities, because exposure may cause disease by the person being exposed once or multiple times and shorter/longer durations. This concept is important in the work of asthma and exposure. Researchers have found that oxidative stress is thought to be what causes most diseases, including asthma. (Sies 1985, Coyle 1993, Mittler 2002, Van Houten et al. 2018) According to Helmut Sies, who first used this term, in his book called "Oxidative Stress and Vascular Disease" (1985)", in which he says, the imbalance between oxidants and antioxidants in favor of the oxidants, potentially leading to damage, forms the core of the definition of 'oxidative stress'. Chemical exposure has been a focus of many studies and has led to oxidative stress and ultimately inflammation in the body (Zeliger 2016, Reuter et al. 2010).

Exposure to certain chemicals have been known to lead to many diseases. The Centers for Disease Control has tried to bring awareness to these toxic chemicals, and to avoid them.

According to the CDC, “A certain amount of a harmful chemical must enter your body to make you sick. Harmful chemicals can get into your body if you breathe, eat, or drink them or if they are absorbed through your Skin.” Not every individual will get sick from the chemical, and this can depend on many factors, which the CDC has listed:

•The kind of chemical you are exposed to,

• How much of the chemical you were in contact with,

• How long the contact lasted,

• How often you were exposed,

• How it entered your body, and

• Your health.

Some of the more common chemicals (according to the CDC) that affect the respiratory system are, Asbestos, Radon, Cadmium, Benzene, and Carbon monoxide. Burger and Gochfield (2011) have stated, measuring chemicals in human tissues is the gold standard for measuring exposure and have pointed out that there could be a network of many factors that are causing asthma. There are multiple facets of exposure.

Air quality has been a major focus in many research studies on asthma. Some have found that fossil fuel combustion has been a primary driver. This includes stationary and mobile sources (Forno 2009, Spira-Cohen 2011). Air pollution may be related to asthma exacerbations through a combination of oxidative stress, airway inflammation, and becoming sensitized to aeroallergens (Orellano 2017 p. 2). Other researchers that have focused attention on air quality and the presence of chemicals with a focus on childhood asthma include Cutter 1996, Liapunova 2011, Tzivian 2011, and

Jerret 2008. As well as Goodman et al. 2017, who found that certain concentrations of ozone and fine particulate matter (PM2.5) are associated with asthma. These have been examples of how exposure of these chemicals may lead to the development of asthma.

Some may argue that TRI data with spatial analysis can give us exposure estimates, (Dent et al. 2000, Conley 2011, Maantay 2007). Research should focus on air dispersion modeling, examination of multiple-buffer exposures, multivariate regression analysis of asthma and socio-demographic data (Maantay 2007).

Exposure and Sickness

Mortality rates due to cardiovascular disease, and carcinogens are also associated with TRI chemical exposures. Hendryx and Juhua (2014) have found that greater amounts of TRI releases are related to higher population mortality rates for cardiovascular disease. In another research, Agarwal et al. (2010) demonstrated that toxic air pollutants, especially carcinogens, were linked to higher infant mortality rates. Ho and Hite (2009) found that greater TRI releases were significantly associated with higher reported number of workdays lost to illness. A study by Hendryx and Luo (2013) found higher hospitalization rates for some cancer types in relationship to carcinogenic releases from TRI facilities.

1.2.3 Proximity:

Distance from pollution sources play a vital role in the prevalence of asthma (Middleton 2014, Rosser 2016, Huynh 2010, Amadeo 2015, Brown 2012). People residing closer to a major roadway have an increased frequency of wheezing associated

with increased medication requirements, greater healthcare utilization, increased airflow limitation and airway resistance, and increased inflammation. These findings suggest an important spatial relationship between the distance from a major roadway and asthma control in children (Brown 2012). Furthermore, Asthma exacerbations increased as traffic levels near the home increased. Proximity to traffic was a significant predictor of asthma exacerbations (Lindgren 2016). In children with asthma, residential proximity to freeways is associated with uncontrolled asthma (Huynh 2010, Perera 2017) Coal-fired power plants are more than likely located in a lower socioeconomic communities (Perera 2017).

To recap this section, I have described the importance of TRI research when it comes to sickness and exposure. The relationship between exposure and sickness has been studied extensively, and is no stranger in the study of health. Also in this section I have listed the importance of proximity analyses in the work of health.

Chapter 1.3. Relationship between socioeconomic background and Asthma.

Chapter 1.3.1 Introduction to Asthma

Asthma is a disease that affects the lungs, in which the airways become narrow because of inflammation. The combination of narrow passage of the airway and mucus production of the cells, further reduces the airway, making breathing very difficult. As stated by Erle and Sheppard (2014, p. 621), “Two airway cell types are responsible for the progression of asthma, epithelial cells and smooth muscle cells. Airway epithelial cells, which are the first line of defense against inhaled pathogens and particles, initiate airway inflammation and produce mucus, an important contributor to airway obstruction. The other main cause of airway obstruction is contraction of airway smooth muscle.” When symptoms occur more frequently or are more pronounced, they may lead to an asthma attack. These persistent attacks are damaging to the airways in your lungs (Brightling et al. 2011). According to the CDC, symptoms of asthma include, wheezing, excessive mucus production, shortness of breath, chest tightness and coughing. There are many triggers that may create an asthma attack, these include, pet hair, pollen, dust mites, smoke from burning wood, exercise, mold, tobacco, allergens, mold and infections from the influenza virus, and outdoor air pollution. Understanding the

underlying factors leading to chronic asthma will be important, because symptoms continue to exist even though patients use bronchodilators and inhaled corticosteriods (Brightling et al., 2012, Erle and Sheppard 2014). Sometimes there are fatal attacks. Since there is no cure for asthma, patients must use inhalers to manage symptoms, and avoid what may be triggering inflammation of the lungs.

Literature on outdoor pollution and the relationship to asthma onset has been studied numerously. Distance from pollution sources play a vital role in the prevalence of asthma (Middleton 2014, Rosser 2016, Huynh 2010, Amadeo 2015, Brown 2012) . People residing closer to a major roadway have shown greater rates of asthma, which supports other existing studies, there is a spatial relationship between the distance from a major roadway and asthma control in children (Brown 2012). Furthermore, in another study, it was found that Asthma exacerbations increased as traffic levels near the home increased. Proximity to traffic was a significant predictor of asthma exacerbations (Lindgren 2016). Residential proximity to freeways is associated with uncontrolled asthma (Huynh 2010 , Perera 2017). Other researchers conclude that coal-fired power plants are more than likely located in a lower socioeconomic communities (Campbell 2010, Burke 1993, Ringquist 2005).

There are certain risk factors for Asthma as well. African American, and Hispanic have higher rates of asthma (Forno and Celedon 2009, Cutter 1996, Faber and Krieg 2002). People that are raised in lower economic background are also at risk. As well as people that have frequent respiratory infections (Pererra 2017). Another risk factor is being exposed to tobacco, both before and after birth. In addition to pollen, outdoor air pollution caused by chemical particulates can be eliminated. Fossil Fuel

combustion is giving rise to asthma and this includes stationary and mobile sources (Spira-Cohen 2011). As cited by Shendell 2007, Environmental factors influence the prevalence and severity of asthma, and likely help cause asthma (U.S. Department of Health and Human Services, 2006). These topics will further be discussed in this paper.

As opposed to urban studies on asthma and outdoor pollution due to fossil fuel combustion exposure as well as chemical pollution in the atmosphere, there are researchers that support what is called the “Hygiene hypothesis” (Alexandre-Silva et al. 2018, Allaerts and Chang 2017, Liu 2015) . As stated by Van Tilber (2017 p. 717) the Hygiene Hypothesis came from research by Dr. David Strachan in 1985 who stated, “Younger siblings were less susceptible to eczema and asthma, and proposed that this was a result of increased transmission of infectious agents via unhygienic practices within a household”. Studies have shown that rural environments give an advantageous protection against asthma (Von Mutius, 200, Ramos 2006). More recent reports from China and Europe have indicated a reduction in the prevalence of childhood asthma in rural settings (Chan-Yeung et al., 2002; Waser et al., 2005). This "hygiene hypothesis" suggests that exposures from farming and livestock tend to protect children from the development of asthma. The authors of the study reported here, however, did not observe a protective effect of a farming environment for adult asthmatics. Lancaster County and Erie County both have substantial agricultural industry, but their adult asthma hospitalization rates were substantially different (Ramos 2006).

However critics of the hygiene hypothesis say that it fails to explain the presence of asthma in the less affluent parts of the world (VanTilberg 2017, Bloomfield 2016, Leong 2016). This may be a topic for study because are there similar patterns of asthma

in urban versus rural, and developed versus developing countries. After reviewing the hygiene hypothesis in his literature, Patel and Gruchalla (2017) have said there needs to be more studies on what genetic and environmental factors cause this disease. For this reason and reviewing other research about the topic of hygiene hypothesis, there seems to be a lack of general consensus about rural and urban environments' effects on asthma. This has led me to focus on outdoor air pollution caused by chemical producing industries. In addition, continuing with the initial studies, Shendell (2007) looked at outdoor air pollution and the relationship with asthma, and would agree with this growing body of literature. "Environmental factors, influence the prevalence and severity of asthma, and likely help cause asthma." (U.S. Department of Health and Human Services, 2006).

1.3.2 Chemical Pollutants Related to the Onset of Asthma

There is a growing body of literature on the relationship between outdoor air pollution, specifically chemical pollutants, in urban settings have had detrimental effects on lung function. Knibbs et al. (2018) research conducted in Australia with school aged children shows just this. Children in urban environments tended to have greater amounts of asthma occurrences with the presence of Nitrogen dioxide in the air. Literature in asthma also shows that there are certain chemicals that should be brought to attention when it comes to the prevalence of asthma. Certain pollutants have been proven to result in adverse effects on human health (Medhi 2016). Medhi focuses on carbon monoxide, nitrogen dioxide, ozone and sulfur dioxide. Medhi's study found that two chemicals that

are byproducts of industrial facilities and these include Sulfur dioxide and Trisodium Phosphate (TSP) (Medhi 2016).

Other studies found particulate matter as a trigger to avoid. Delfino (2003) and Li (2014) find that PM 2.5 concentration are important, whereas Delfino also sees PM 10 concentration is also significant. Asthma onset appears to be associated with residential exposure to particulate matter, ozone and nitrogen dioxide (Tétreault 2016). Orellano has concluded that, Air pollution may be related to asthma exacerbations through oxidative stress, airway remodeling and inflammation, and sensitization to aeroallergens (Orellano 2017).

Both SO2 and NO2, which are created from combustion, have been associated with respiratory distress and can irritate lungs and increase the likelihood for asthma (Chen et al. 2007, Kampa and Castanas 2008). Atmospheric particles, including acid aerosols derived from sulfur dioxide emissions, have been linked with worsening of symptoms, reduction in lung function, increased hospital admissions for asthma and increased use of medication. (Fazzo et al. 2017). In another study conducted by Goodman et al. (2017), found that ambient ozone and PM2.5 are associated with asthma hospital admissions among school-age children in New York City, and these associations did not vary by SES.

Dolinoy and Miranda (2004), have looked at Glycol ethers as a chemical that was studied in air pollution that causes respiratory problems in people. in Durham County, North Carolina. Ethylene glycol monobutyl ether is a nonphotoreactive volatile organic compound used as a solvent during printing processes. It is a suspected

cardiovascular, blood, developmental, endocrine, gastrointestinal, kidney, neurologic, and respiratory toxicant (Dolinoy and Miranda 2004).

1.3.3. Individual Characteristics:

Individual characteristics in asthma prevalence can include race, gender, BMI, socioeconomic characteristics and age. Franziska et al. (2016) looked at how socioeconomic status influences the presence/ onset of asthma in certain ethnic minorities. There most certainly seem to be ethnic disparities in asthma. Indoor and outdoor quality, smoke exposure, and access to healthcare are some factors that are correlated with ethnicity through socioeconomic status. He also found that genetic variation (which is also correlated with ethnicity) also has ethnic disparities in asthma. This factor is also important to look at because genetic variation can act independently, but it can also act alongside socioeconomic status (Forno 2009).

Poor children are at higher risks of contracting diseases from this kind of pollution. Perera (2017) also argues here that the reduction of fossil fuel usage will greatly be a positive impact on children health because children do spend more time outdoors.

Perera 2017, Bedolla-Barajas 2015, and Huang 2017 have found in each of their individual studies that young age plays an important role in Asthma severity, and the behavior of Asthma. Huang et al. (2017) states, early childhood is considered the most critical stage for the development of atopy and asthma. Perera also argues here that the reduction of fossil fuel usage will greatly be a positive impact on children health. “The

fetus and young children are more vulnerable to the harmful effects of pollutants. Their bodies are still developing, as well as the billion of neurons in their brains. Being susceptible to genetic damage in these years also add to the reasons as to why research needs to be focused on this population" (Perera 2017 p. 16).

Chapter 1.3.4 Confounders:

In a recent research, Milanzi (2017) has found, when it comes to Second-Hand Smoke exposure and Asthma, there seems to be a general agreement in the literature which says that increase of SHS exposure will also show an increase in Asthma severity. Hollenbach et al. (2017) states, "The odds of Black and Puerto Rican/Hispanic children with asthma being exposed to SHS were twice that of Caucasian children. Children with asthma exposed to SHS are at increased risk for more severe symptoms and for asthma exacerbations as compared to children not exposed to SHS" (Hollenbach et al. 2017 p. 12). Exposure to SHS during prenatal and early life shows an increased risk of asthma during the first 10 years of life. Milanzi (2017).

Diesel exhaust has been seen as a confounder and could be a significant contributor to the worldwide increase in asthma and other type 1 hypersensitivity disorders has been stated by Crinnion (2012). This work would also support other literature on traffic related asthma, and studies related to proximity analyses with those that live closer to freeways and major roadways.

Another confounder when it comes to Asthma is obesity. As cited by Koebnick (2016), people with obesity were more likely to have greater exacerbations compared to patients with asthma who are normal or overweight (Koebnick 2016, Taylor 2008,

Boulet 2008, Matricardi 2007, Sideleva 2013). BMI also plays a role in asthma occurrences. The risk for adult-onset asthma was strongly and positively associated with BMI categories (Koebnick 2016). The same kind of conclusions were not made by Bedolla (2015). Bedolla et al (2015) on the contrary says, that there are differences in age of Asthma onset in relation to BMI, Therefore, prevalence, severity, and control of Asthma in relation to obesity remains controversial.

As cited by Osbourne 2017, Exposure to pollen can contribute to increased hospital admissions for asthma exacerbation. (Chakraborty 2016, Osbourne 2017, Kazuhiko 2015, Marchetti 2017, Gonzalez-Barcala 2013).

Another confounder when it comes to asthma is cockroaches. As stated by Do et al. 2016, Cockroach sensitization is an important risk factor for the development of asthma. (Do et al. 2016, Mattison 2017, Woodfolk 2016)

Exposure to molds have also had an effect on the occurence of asthma. (Baxi 2013, Polyzoi 2017, Ogawa 2013, Mendell 2011)

Pet dander has also been a confounder when it comes to asthma. (Eldeirawi 2018, Carlsen 2012, Svanes 2008)

Exercise induced asthma is a confounder (Belanger 2016, Molphy 2017, Kurowski 2017, Papaioannou 2014).

To recap, this section of the paper has highlighted what asthma is and what chemicals have been linked to asthma onset. Furthermore, this section has also focused on socioeconomic background and the relationship to asthma. Individual characteristics and confounders have also been discussed.

Chapter 1.4 Housing Segregation-Redlining- Restrictive covenants- Block busting

Chapter 1.4.1 Redlining

Redlining- The issue of redlining became well-known amongst the public when the Atlanta Journal in 1988 created articles that were titled “The Color of Money” (Dedman 1988, Silverman 2005). The aftermath of these articles brought awareness to the public about housing market discrimination. White people living in Atlanta, Georgia were getting an unfair advantage in mortgage lending, while African Americans were discriminated against. These articles allowed researchers to focus on problems throughout American neighborhoods and eventually making it illegal in 1968 by the Federal Housing Act (Silverman 2005).

Adding to this research, Ross and Yinger (2002) have found there are differing of opinions when it comes to redlining. While some researchers will say that other factors such as, housing stocks are associated with mortgage lending has more to do with economic status (Perle et al. 1994, Hula 1991), there are others who say that race plays a major role in redlining. This topic can be considered controversial.

Beyer et al. (2016), in their research, have found that redlining is different from racial bias in mortgage lending. What distinguishes them from each other is that redlining is about denial of mortgages to specific neighborhoods, whereas racial bias in mortgage lending, To show support of this claim, the authors used the Home Mortgage Disclosure Act (HMDA) database to measure both of these concepts.

Consequently, this time period in history shows that many were restricted in choices of places they could buy homes. African Americans were denied mortgages and confined to ghettos (Shlay 1988, Shlay 1989, Coffey and Gocker 1998, Stapinski 2009, Silverman 2005) and that gaps exist among the races, Wyly and Holloway (1999). Redlining (although discreetly) continues to exist in Detroit (Silverman 2005). Gotham (2002 p. 84), has said that "the real estate industry has defined and marketed racially homogeneous, White neighborhoods, as socially and culturally superior, with higher property values, and access to quality schools and other social services (Gotham, 2000, Mohl 1997).

Neighborhoods that are predominantly African American in composition have likely shown in studies low property values, neighborhood deterioration, and negative consequences such as poverty, violent crime, drugs, poor schools, etc. (Massey and Denton, 1993, Feagin, 1994). These redlined areas have shown instability which include the inability to move up on the social ladder (Rutan 2017). The disparities that continue to be carried on through generations have also created other areas of concern such as lack of neighborhood investment, stable financial means, and passing this wealth to their off-springs (Sharkey 2013, Hyra and Prince 2015, Desmond 2016, Rose and Brooke 2013).

The National Community Reinvestment Coalition (NCRC) has found that "Reduced home values led to increases in default rates and decreased investment in home improvements. This resulted in the physical deterioration of the housing stock, a primary cause of neighborhood blight." In essence they have stated that reduced home values leads to blight. This non-profit organization's focus is to help struggling communities find basic banking services, affordable housing, job creation, by increasing the private capital flow to these selected communities. In their research conducted in 2018, this organization has found that the redlined maps that were created by the HOLC, covering 200 cities across the U.S., is still apparent in the segregated communities that exist today. The imperative claim that they stated can be supported by other literature, "Intractable concentrated poverty continues to plague these cities, and by using data not available to the public the Fed has shown that this is directly linked to the misguided early redlining efforts of the federal government. The study shows that landmark civil rights legislation, such as the Fair housing Act of 1968 and Community Reinvestment Act of 1977, helped spur some investment in the hardest hit areas but hasn't reversed decades of legal segregation." This organization meets with local, regional and the federal government to highlight the concerns of their constituents, and with their various efforts, are leading the way for uplifting the poverty-stricken communities. There have been many instances where socially class-based zoning are means to control individuals from acquiring homes. Rose and Brooke (2013, p. 311) has found that, "while race-restrictive public zoning laws are illegal, class-based public zoning laws were legal, and these exclusionary laws shut certain disfavored homeowners--typically Blacks, Latinos, and lower-income Americans--out of certain neighborhoods." Housing segregation has

been in the forefront in their topics of research. Ultimately, it is housing segregation that leads to the destruction of a community's well-being.

1.4.2 Blockbusting

Black neighborhoods also came into formation due to blockbusting. Blockbusting was a tactic used by real estate agents, in which they would instill fear amongst the White property owners to sell their property at a much lower price because the neighborhood would be populated with Black people. Once that property was sold, they would sell that property to Black people for a much higher price (Orser 1990). With their misleading but highly successful methods of blockbusting, these real estate agents had changed the demographics of the community with their manipulation in sorting Blacks in certain areas. Gotham (2002 p. 95) has described this phenomenon as the "invasion succession model". Here the author states, "the neighborhood of a higher status group, the latter will view this [the movement of Blacks into their neighborhood] as a threat to their social status and move out, allowing the lower-status group to "succeed it." A considerable amount of literature on this model emerged in the 1950's and 1960's (Wood and Lee 1991). The more popular of these works are from Duncan and Duncan 1957 and Taeuber and Taeuber 1965. Although Wood and Lee (1991), have concluded in their findings that the invasion succession model does not hold universally. Temporal and spatial context of the neighborhood needs to be looked at primarily, to make the succession model more accurate. In their literature review, Wood and Lee have also listed many others that were critical of the model. Included here are: (Goering 1978; Rapkin and Grigsby 1960; Taub, Taylor, and Dunham 1984; Wolf 1963). The work that

has been created by Wood and Lee (1991) has been valuable to this topic of research because it is thorough and comprehensive. They have covered a large time period as well as many cities that consist of racially mixed neighborhoods of Philadelphia, Chicago, New Orleans, Los Angeles, and Washington, D.C., from 1940 to 1980 and offer regional comparisons, using 38 large cities from across the United States.

In his study of a neighborhood of Baltimore, Orser found, twenty thousand White residents left the city of Baltimore from the years 1955 to 1965 (Orser 2015). In West Baltimore, specifically Edmonson village, Orser finds that the blockbusters were able to get the White people to leave the community, while letting African Americans to settle in the community at high prices. Orser (2015 p. 227) states that "Over the past two decades scholars have identified remarkably similar instances of blockbusting in such cities as Baltimore, Boston, Chicago, Cleveland, St. Louis, and Kansas City." He says that blockbusting may not have caused White flight, but that it did expedite the process. "Leaving systematic resegregation in its wake." About 3.5 million African Americans had migrated from 1910 to 1940 to northern cities, and this great migration increased demand for housing in city centers (Collins 1999 p. 495, Ouazad 2011).

Another example of blockbusting has been mentioned by Ouazad 2011 and Seligman 2005, in which the authors say that Chicago's Westside had also seen blockbusting occur during the 1970's.

1.4.3 Restrictive Covenants

Restrictive covenants stated by Jones-Correa (2000) were agreements restricting those that were not Caucasian from occupying or owning property. The Supreme Court case, Corrigan v. Buckley (1926) decision legally enforced the private contracts of these covenants.

Jones-Correa (2000), has stated that most literature on this topic agree that Restrictive Covenants had become popular after the Supreme Court case of Buchanan v. Warely (1917). Rose (2016, p. 940) states that after the Federal courts had struck down this case of (1917), other substitute laws had sprung up. But shortly afterwards these substitute laws were also struck down as being unconstitutional, which led many of the White elite to turn to restrictive covenants, as a means to continue their agendas. The Court said racial municipal zoning is banned after this case Jones-Correa (2000).

It was not until another Supreme Court case, Shelley v. Kraemer (1948) that outlawed racially restrictive covenants (Ocen 2012). Adding to this literature, Rose and Brooks (2013) has found that racially segregated neighborhoods continue to exist because of restrictive covenants, even though they were outlawed, and segregation by income continues to be a problematic issue. Here the authors Rose and Brooks (2013) have stated that after the case of Shelley V. Kraemer, many White homeowners took action, (although not illegal) such as threatened and violence to get rid of the Black people from living in their neighborhoods. Furthermore, local officials would pay the

Black people to move out of their neighborhoods. To further affirm their agendas, White political leaders and White police officers would warn African Americans that they would not receive police protection if they stayed in White neighborhoods (Rose and Brooke 2013).

Jones-Correa (2000) has also found that there were differences in covenants that were made in urban versus suburban cities, as well as newer and older cities. In his research of Chicago Jones-Corea says, that covenants that were created in older neighborhoods were put in place once there was a unanimous agreement from property owners in that certain area. This took a lot of time and it cost much more, whereas in suburbs, covenants were made into deeds before the arrival of the newcomers.

Public housing has been a means to control where Black and minorities can live, Taylor (2014). Two factors took place simultaneously and created a concentration of Blacks in public housing, blight and deterioration of the inner city, and White suburbanization, Bickford and Massey (1991).

1.4.4 The question as to whether redlining has lead to the location of tri facilities?

Dorceta Taylor (2014)'s book titled "Toxic Communities" has been an imperative work of research when it comes to Environmental Justice, as well as playing a major role in guiding me in the direction of my research, which is to look at how redlining and discriminatory zoning laws continues to have impacts on these underprivileged communities. Taylor makes an important claim about segregation and its effect on the formation of communities in the United States. Residential patterns that we see today are because they of Historical Discriminatory Zoning laws put in place

decades before, Taylor (2014). She argues that there were methods to restrict the movement of Blacks and minorities in certain areas of residences. Of the seven purposes of these laws, the one that is most relevant to this research is , "Designate Black and other minority neighborhoods as commercial, industrial or manufacturing districts", Taylor (2014, p. 150) Zoning has played a major role in the placement of people of color throughout the history of this country. There have been many instances where socially class-based zoning has been a means to control individuals from acquiring homes, Rose and Brooke (2013).

Racial segregation has played a role in health disparities. Racial segregation and racial health disparities are linked to one another (Beyer 2016). Whereas exclusionary zoning has been the main focus of Schindler (2015) research and relevant to this section of study.

Chapter 1.5 Different types of Methodologies

According to Dent et al. (2000), air dispersion modeling in combination with GIS are good methods for finding health outcomes. Dent et al. (2000, p. 161) argue that, modeling/sampling allows better "refinement in location, size and demographic composition" of the exposed population.

Sheppard (1999), says Geographic Plume Analysis allows toxicological characteristics of the chemicals emitted to be focused on, physical characteristics of the sites, and atmospheric conditions to identify the geographic area and population that is affected by a plume. However, Sheppard (1999) also says that plume models are time consuming.

According to Sheppard et al. 1999, one common method is the Spatial Coincidence method which is best used when there is census data at the tract, block-group and block level.

The other common method according to Sheppard (1999) is buffer analysis in which proximate populations are defined as those living within a predetermined distance from a TRI site.

Also to keep in mind is what Dolinoy and Miranda (2004) have pointed out. Dolinoy and Miranda 2004 found that inclusive modeling of all facilities, accomplished by imputing emissions to non-TRI-reporting facilities in the same (Standard Industrial Classification) SIC code, rather than modeling of TRI sites alone. When this method is followed through, the authors have found that there is drastic changes when it comes to the distribution of spatial modeled air concentrations. It was Morello-Frosch et al. 2002, who found that Other traditional environmental justice analysis of industrial siting has focused on the location of facilities and not on concentration distributions and exposure.

1.5.2 Methodologies used in TRI and chemical air exposure:

Drawbacks of using GIS: There are a number of limitations in using GIS for environmental justice and health research, according Maantay, this includes “spatial and attribute data deficiencies, and methodological problems, especially those related to geographical considerations”. (Maantay 2007). When bias is present, geocoding can be beneficial, especially when it comes to using data at the census tract and block group level, Zandbergen (2006). Besides bias, the researcher must also keep in mind how air disperses, it does not disperse equally in all directions, (Maantay 2007). Adding to this

literature, Dolinoy and Miranda (2004) have said that environmental justice research has focused on industrial siting, and not on exposure or how pollution disperses. For this reason, Dolinoy and Miranda (2004) have used multivariate statistical analysis on the relationship between concentration and race and income. Four geographical levels of resolutions were looked at, Zip code, census tract, census block group, and census block as the dependent variables. This has allowed them to look at distribution of contaminants. Understanding these methods and procedures are beneficial when studying exposure estimates.

Conley (2011) says, that studies on spatial analyses of toxic pollution have used simple spatial estimate of exposure. Exposure has been recorded as either being exposed or not exposed. (Conley 2011, Bowen 1995, Pastor 2005, Croen 1997). Spatial interaction modeling approach is better because it is a faster method and can be applied to an unlimited number of release sites. Conley (2011). Spatial interaction modeling was developed in economic geography to estimate the level of economic interaction between two towns (Conley 2011, Batty 1972, Baxter 1983, Sen A 1995 and Shepherd 1984).

Creating a buffer:

Buffer analysis in TRI studies have been varied and agreement on any one distance also has not been agreed upon. As cited by Shultz et al. (2017), an 800 m buffer from an industrial has been cited in the literature when analyzing total respiratory health effects from nearby industrial site exposures.

Maantay 2007 states that Proximity buffers are created based on a fixed distance to each of the types of pollution sources. Often, studies have found that there are differences in air quality when it comes to the air concentration inside the buffer compared to the outside. There is no agreement on the buffer distance range. Ebisu (2011) states that buffer distances of 100–2000 m at 10 m intervals are used depending on the land use.

Research also shows that racism is not seen at certain geographical levels, especially at the census tract level; the exception is with a 2.5-mile radius Anderton (1994). Furthermore, other research that supports a radius of 2.5 or higher has been found by the NAACP, "People living 3 miles near a coal firing plant have a lower per capita income compared to the national average, these plants are more disproportionately located in communities of color" (Outka 2017 p. 792). While others may find that buffer analysis is not the preferred method of choice, direct measurement of personal exposure or dose is the preferred way of testing hypotheses (Perlin 1995).

1.5.3 Methodologies for measuring Segregation:

According to Kramer and Hogue (2009), segregation is expressed as a comparison of the sub-areas to the overall area. The authors say that one way of measuring is using two scales of geography, subareas, such as neighborhoods, and an overall geographic area, in which the example can be a city. It is Massey and Denton (1988) who had described five dimensions of segregation: evenness, isolation, concentration, centralization and clustering. These dimensions allow us to see segregation in many regions across the United States and studies elsewhere. However,

Kramer and Hogue (2009 p.185)) say that there are downsides to using census tracts, and that this can be an arbitrary way of measuring segregation. The authors say that census tract boundaries may not allow segregation to be measured correctly with the traditional indices. Kramer and Hogue (2009) have suggested new indices and are proponents of furthering the dissimilarity index, as well as the isolation index. Choosing the right scale will depend on finding the suitable indices.

Logan and Martinez (2018) study of segregation in many cities have led them to a criticism in the more popular (conventional) methods of studying segregation. These authors say Census block counts can leave out segregation when it comes to the alleys and side streets. The authors say that segregation can be seen in greater distances but becomes harder to measure in smaller distances. To alleviate this problem, Logan and Martinez (2018) have found that it needs to be applied to geocoded data. It is important, they say, that researchers must become familiar with distance scales (25 meters, 100 meters, 500 meters etc.) and keeping in mind of denser places versus those that have experience sprawl.

Criticisms of using zipcode data, instead of Census Data for analysis of environmental risk burden was called out by Foreman (1998) and Ramo (2000), in the study by Mohai and Bryant (1995).

Hot Spot Analysis allows you to find statistically significant clusters. This analysis uses vectors and allows for comparisons of low and high values of clusters, and in order to do this points are compiled to polygons . The CDC can use this type of analysis to compare different disease hotspots, and it is often used in epidemiology studies. It is important to have clustering in the dataset before a hotspot analysis can take

place. According to arcGIS pro, “To be a statistically significant hot spot, a feature will have a high value and be surrounded by other features with high values as well. The local sum for a feature and its neighbors is compared proportionally to the sum of all features; when the local sum is very different from the expected local sum, and when that difference is too large to be the result of random chance, a statistically significant z-score results.”

1.6 Theoretical Framework:

In this section of the paper, I will focus on the term “environmental justice”, and how this falls in the realm of social theories. Empirical data cannot measure “environmental justice” and therefore it is a term that is still being studied. There are different aspects of environmental justice, this includes access to healthy food stores and open green spaces, access to healthcare and access to clean air and water. In this earlier piece of literature, Pellow, describes the importance of having clear definitions of what environmental justice is. He says, that often literature on environmental justice use the term environmental racism and justice interchangeably. When we do this, we are not analyzing the same concepts. To fill this gap in environmental justice literature, Pellow (2000 p. 581) had created the EIF model. This model was created to show the missing parts of environmental justice literature that are overlooked. Pellow (2000) has emphasized the importance of process and history, the significance of stakeholder groups and relationships as well as, understanding that there is a life-cycle when it comes to the studying hazards. In short, the author says that it is important to see environmental justice as a process and not a individual and specific event. The second of

these perspectives is that environmental justice has multiple stakeholders, and that it should not be seen as a "victim-perpetrator scene."

The question of why some health disparities end up affecting some groups more than others has been common in the study of environmental justice, Bryant (1995), Krieg (2005), Pellow (2000). Weinberg (1998) questions why some minority groups are disproportionately exposed to toxic waste. Weinberg (1998) explains the difference between environmental racism, environmental justice and environmental inequality, in which he says are different from one another.

As quoted by Pellow (2000 p. 582), "from a social movement perspective, environmental racism is what activists are fighting against. But what are they fighting for? That brings us to environmental justice. Whereas the term environmental racism focuses on the disproportionate impact of environmental hazards on communities of color, environmental justice is focused on ameliorating potentially life-threatening conditions or on improving the overall quality of life for the poor and/or people of color…. Unlike environmental racism, for example, environmental inequalities include any form of environmental hazard that burdens a particular social group". This quote is important to keep in mind, because Pellow (2000) says that environmental justice is unfair when one racial group carries a greater burden in the amount of hazardous facilities located in their communities compared to white communities.

Krieg, makes an important point in the study of unequal distribution of hazardous facility siting. "Statistical snapshots'' at a single point in time do not inform as to whether lower income communities and communities of color are having ecological hazards come to them or if ecological hazards deflate real estate values to the

point at which contaminated areas become financially accessible to lower income populations" (Krieg 2005 p. 200). This perspective is also important to note because Krieg (2005) is trying to say that the relationship between poorer neighborhoods and ecological hazards should be studied over time.

In an older study, Helfand and Peyton (1999), say that often times facilities are seen as discriminators, this should not be the case, knowledge of the community's characteristics are important to consider, before we can say that the situation is environmental justice issue.

Other discussions about environmental justice say the contrary, that "correlation does not mean causality", and this includes works by Been 1994, and Boerner and Lambert 1995. Discrimination at the time of siting, as well as market dynamics need to be considered. Furthermore, Helfand and Peyton (1999) says that educational attainment as well as access to community decision-makers need to be considered.

Literature on environmental justice has defined it in various ways. Some authors have defined the term as when quality of life has been compromised. As mentioned by Helfand and Peyton (1999), authors such as Bullard (1983) and Gelobter (1992) have said, lower and working class have a lower quality of life as compared to the middle and upper working class. Their workplace and neighborhoods have disproportionately greater amounts of pollution.

1.6.1 Coase Theorem

The purpose of briefly reviewing the Coase theorem[3] is important into understanding why industries (and specifically in our case) why industrial polluters locate where they do. What kinds of factors are in play when it comes to location decisions? According to Encyclopædia Britannica ("Ronald Coase", 2018), "when information and transaction costs are low, the market will produce an efficient solution to the problem of nuisances without regard to where the law places the liability for the nuisance." As mentioned above, environmental justice literature has often made the relationship between toxic polluters and neighborhoods as perpetrator and victim scenarios. In addition, the Coase theorem allows us to see the multiple stakeholders that play a part in this decision. Hamilton (1995) says that polluting industries take into consideration property values and the number of people living near them. To understand this from an economic point of view, we need to understand the Coase theorem.

Facilities, whether they include landfills, undesirable land use, and pollution creating industries make their location decisions by following the Coase theorem, which implies that they will locate where they minimize their monetary loss. They also take into consideration the amount of money that may possibly contribute to litigation and

[3] Ronald Coase (1960) British American Economist

other compensation costs, associated with locating in that area, Irvin and Stansbury (2004 p.55) and Hamilton (1995).

Irvin and Stansbury (2004, p. 55) have stated, the Coase theorem is focused on transaction costs, and residents' political power, "either expressed or latent, importantly affects the current and potential transaction costs of a location" (Irvin & Stansbury 2004). The result of this creates differences in the number of negative land uses in vulnerable neighborhoods, while privileged communities have no effect on the consequences. Hamilton (1995) makes an important suggestion for such industries to alleviate some future problems that may take place in that neighborhood. "In calculating potential compensation costs, therefore, the efficient firm should take into account various characteristics of neighborhoods such as the number of people affected (all else equal, more people results in more potential compensation), incomes and property values, and residents' willingness to pay for environmental amenities" (Hamilton, 1995 p. 130).

1.6.2 Models of Environmental Inequity--Institutional vs. Intentional

There are two main models of environmental inequity that are described by Eckerd (2017) and Downey (1998). The Institutional model puts forth the idea that communities that are privileged continue to gain more privileges. Whereas, the "intentional" model says that minority communities are discriminated against, and gain disamenities (Downey 1998). Downey (1998) notes that "[i]nstitutional models provide a theoretical basis for expecting that race and income will be highly correlated. If income and race are highly correlated, statistical models may have difficulty separating

out the effects of each", Downey (1998 p. 775). The author has implied that since race and income have factors that are sometimes intertwined, it is difficult to pinpoint whether the institutional or the intentional model are in play.

Thus, it is difficult to distinguish an institutional discrimination argument, like the concept of "White privilege" (Pulido, 2000 p.15), from a market- based argument concerning residential sorting around undesirable land uses (Been & Gupta, 1997 p. 34). The same results can be inferred to be consistent with either argument". These authors bring important arguments about which model is plausible, or if both are. It would be a difficult task to measure white privilege.

Other problems that may arise is that communities that tend to gain disamenities make it easier for other disamenities to locate there too. Eckerd (2017) describes these as, "agglomeration economies". Since these communities never used their exercised powers, as well as their latent powers to fight these industries, they continue to become vulnerable to such industrial polluting firms. Furthermore, Eckerd (2017) has found that amenities being located in privileged communities also may detract disamenities to be located in the same community. There needs to be more research on how amenities affect communities as opposed to focusing attention on disamenities when it comes to environmental justice.

Pulido (2000) says that to understand environmental racism it is important to also look at White privilege. Here Pulido (2000) explains, White privilege is a way for White people to preserve power/privileges. This idea is relevant to the institutional and intentional models. Sometimes, White privilege gives an advantage (politically, socially and economically) to this group of people.

Cutter (1995) brings about vital questions to the area of environmental justice, and this debate continues to ensue.

"Which came first? Were the LULUs [locally undesirable land uses] or sources of environmental threats sited in communities because they were poor, contained people of color and/or politically weak? Or, were the LULUs originally placed in communities with little reference to race or economic status, and over time, the racial composition of the area changed as a result of White flight, depressed housing prices, and a host of other social ills?" (Cutter 1995:117)

The institutional model as well as the intentional model in Environmental justice literature mirrors similar models such as the Traditional Ecological Model (TEM) and the Dual Housing Model (DHM). Competition arises between different racial groups for the best housing. This model is supported by Kasarda (1972), Berry and Kasarda (1977).

The other theory that is considered the "rival theory" is the Dual Housing Model. Proponents of this theory believe that the dominant group are able to have access to the best housing in the region, while the less powerful group ends up having lesser quality housing. In their words, "segregation ensues because Whites not only preempt the best housing in urban centers but monopolize new construction in suburbia too. Consequently, minorities are left with inferior housing and restricted choices" (Sterns and Logan 1986, Taylor 2014, p. 149).

The conversation of political power and discrimination are factors that need to be looked at as well. Helfand and Peyton (1999 p. 69) have stated, "Unlike historic racism, which primarily affects individuals through their endowments, current discrimination is said to require power (United Church of Christ, 1987) and thus lies in the domains of

industrial managers, community decision-makers, and favored groups in the population. From this reading we can understand that active participation by a network of political leaders, as well as larger economic entities in enforcing discrimination tactics has taken away power from certain ethnic groups and people that are poor.

1.6.3 Controlling for Income and Class

Campbell 2010 has found that when controlling for income and class, many Environmental justice studies conclude that minorities carry a greater burden of dwelling near disamenities. (Campbell 2010, Burke 1993, Ringquist 2005) as well as low-income neighborhoods Faber and Krieg (2002). Burger and Gochfield (2011) as well as Burke (1993) have found, that when income was controlled for, ethnicity still played as an important variable.

Burger and Gochfield (2011) have said, that although authors such as Ringquist (1997) have looked at uneven exposure to toxic contamination, it is better to ask why these greater risks exist. Authors that are critical of this method say that discrimination is not the conclusion to be made. Campbell (2010) and Helfand and Peyton (1999 p. 71), have said that, “While the correlational studies show differences by income and racial classification, they do not prove that discrimination or other undesirable forces are at work.”

1.6.4 Well-Being is important when it comes to Environmental Justice

When it comes to environmental justice, Edwards (2016), says there is little research on well-being and environmental justice. “As it stands, however, well-being

remains under-theorized in the EJ context, something which the capabilities approach seeks to give form to but which remains out of direct sight" (Edwards 2016 p. 760). While some authors conclude that well-being is a state of mind, where one is content with their life ((Diener et al., 1999; Kesebir and Diener, 2008; Pavot and Diener, 1993; Tiberius, 2004); other authors will say that well-being is more about "satisfaction" with one's own life ((Huta and Ryan, 2009; Ryan and Deci, 2001; Ryff and Singer, 2008). While some authors have also focused attention on external conditions such as physical health, (Ryff et al. 2004), other research shows that external conditions may not play a huge role in whether people describe themselves as having a content well-being. In some studies and surveys people will say that their well-being is high, even when health conditions will be poor and they may still be living in poverty (Fleuret and Atkinson, 2007). Edwards (2016) says that the environmental justice movement has not "explicitly defined" what well-being means. (pg 765).

Less Stringent Regulations

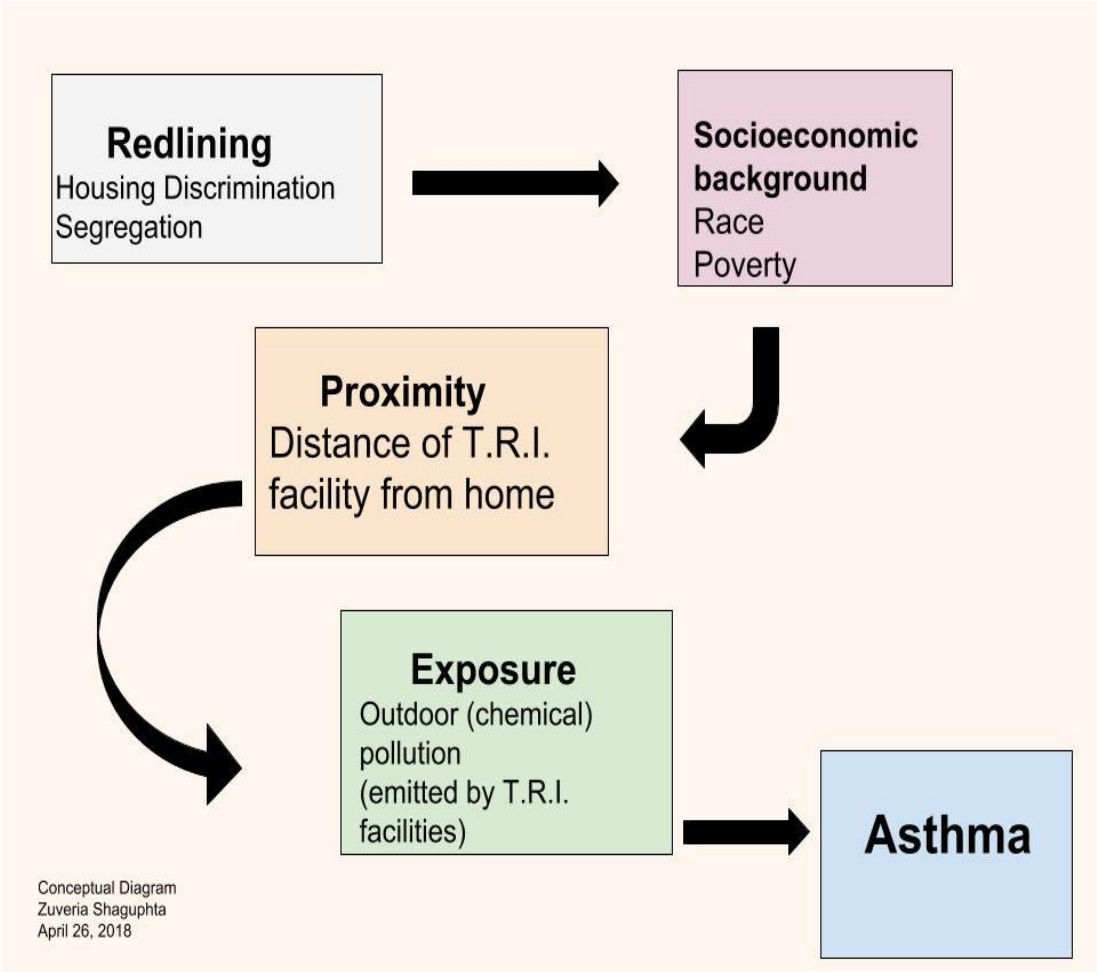
When it comes to environmental justice, local and regional governments must not neglect their constituents, especially the inhabitants of their municipalities. Governmental regulation plays a major role in the process of facility sitings. Konisky and Reenock (2013) say that environmental inequity is when there is unequal protection and unequal enforcement of laws across groups.

Konisky and Reenock (2013) have found that less stringent regulations mean there will be higher levels of pollution and toxic polluters become more inclined to locate in jurisdictions with "lax enforcements". Furthermore, in this research, Konisky

and Reenock (2013) also found that toxic facilities located in Hispanic communities were not punished for breaking regulation codes. The authors say that very little studies have found governmental enforcement in low-income and as well as minority communities, as well as distinguishing the differences between minority communities. These authors also agree that there is lack of power from poor neighborhoods have (Konisky and Reenock 2013).

Environmental justice literature also focuses attention on factors such as discriminatory siting. Housing discrimination and poverty can lead to environmental inequities, and not necessarily discriminatory siting, Been (1994). Intent and historical evidence has become the main purpose of study (in more recent studies) says Abel (2008). Often more than not, there is a correlation between poverty, lower educational attainment and less access to community decision-makers, Helfand and Peyton (1999). Therefore, these minority people tend to lack political power and often do not have enough authority to prevent noxious facilities to locate in their neighborhoods. Although a little older in the literature of environmental justice (and just as relevant), a few hypotheses regarding environmental quality, and the reason as to why segments of populations end up living near polluting producing facilities have been stated by Helfand and Peyton (1999). The first of these is that minorities tend to be less affluent than Caucasians, and facilities will locate in an area where property values are low. The second of these hypotheses is low educational attainment. Awareness about pollution and avoidance may not be something they are knowledgeable about. The third of these hypotheses is that the poor and minority have little political power. Lastly, the fourth of these hypotheses is that racism is present.

To briefly review this section, literature on environmental justice agrees that it is multidimensional in that there are many aspects of environmental justice exist. Over burden of ecological hazards is one aspect that has been studied numerously. Pellow (2000) says that there needs to be clear definitions, and that environmental justice and environmental racism are two different things. Furthermore, authors like Krieg (2005) have said that statistical snapshots aren't sufficient when it comes labeling that environmental justice has occurred. Helfand and Peyton (1999) say that factors such as time of siting and market dynamics of the region need to be considered. Other authors such as Bullard, would say that environmental justice can be labeled so, when quality of life has been compromised and authors that have said that it is important to focus attention on well-being when it comes to environmental justice. In this section, I have also paid attention to how the Coase theorem is important when it comes to market dynamics. To further the discussion on environmental justice I have also reviewed other literature topics of models of environmental inequality such as the intentional and institutional model. These models are important to understand because we can see what kinds of measures have been put into play. In addition, I have brought forth the existing arguments of how lax regulations encourage environmental justice (Konisky and Reenock 2013).



1.6.5 Conceptual Diagram linking Redlining, Socioeconomic background, Proximity of TRI facility, Exposure and Asthma

Figure 1. Conceptual Diagram linking redlining, socioeconomic background, proximity of home from TRI facility, exposure and asthmaFigure 2. Conceptual Diagram linking redlining, socioeconomic background, proximity of home from TRI facility, exposure and asthma

This conceptual diagram (figure 1) is the foundation for this paper and shows that redlining of the New Deal period created by the HOLC, had separated African Americans, minorities and those that were less affluent to live in designated areas of many cities. This intentional segregation has continued to create poverty-stricken neighborhoods. Poverty may also lead to less resources and therefore lack of beneficial changes to those neighborhoods, which may include poor physical infrastructure and crime. The lack of social mobility that has had lasting impacts on the African American and Hispanic populations continue to be in existence today, nearly eighty to ninety years later. As of my knowledge, no research has focused on redlined areas and the disease outcome of asthma. This study builds on Taylor (2014) and Krieg (2005), particularly in that discriminatory zoning laws have created direct problems with residential patterns, Taylor (2014) and environmental justice research of Buffalo, New York, Krieg (2005). As reviewed in the literature, minority populations tend to live in neighborhoods that have greater amounts of disamenities. Among these disamenities are toxic release inventory facilities. Literature also shows that those living near these toxic emitting facilities are more exposed to the chemicals produced, and unintentionally become susceptible to many diseases such as asthma. Reiterating from above, literature also supports the concept that individuals that are exposed to toxic fumes from outdoor pollution have greater incidences of asthma. This three part analysis aims to bring light

to the fact that redlining has had long lasting impacts on the African American and Hispanic populations, in which they carry a greater health risk burden of chronic asthma. My hypothesis questions are whether formerly redlined areas have a greater number of Toxic Release Inventory facilities, and whether we see greater rates of asthma. This research will provide more insight into environmental justice in the study areas of New York State, and implores others to find if there are similar patterns of the lasting impacts of redlined areas and the occurrences of asthma across the United States. As a review, see brief description of analysis (and will be described in detail in the methods section, following the literature review.)

Three part Analysis:
1. Redlined maps compared to current maps, show that segregation still exists since a considerable amount of Blacks/Hispanics are still living in those zip code areas (U.S. Census data shows this).
2. These populations live in closer proximity to toxic facilities. (Location of Toxic facilities in relation to socioeconomic status.)
3. Does this relate to asthma prevalence? (Asthma rates in hotspot areas compared to those that are not) Hotspot areas will show a statistical significance of TRI facilities in the area.

Hypothesis: African Americans and Hispanics have higher rates of asthma and are more likely to live near Toxic Release Inventory facilities.

Chapter 2

MATERIALS and METHODS

I. Study Area

The study area of Buffalo, New York has been chosen for a number of reasons. When looking at the redlined maps[4] (1937), this city shows a decent number of minorities and African Americans were residing here. Many other cities had little to no establishments of minorities in Upstate New York, and in particular a population count of African Americans. Some of the documents created by the HOLC have been inserted in this paper for reference purposes. The second reason for choosing Buffalo, New York as the area of study is because this urban center saw drastic changes in economy, which also affected the minority populations. Hence the influx of African American communities emerging in the city. The geographical area of Buffalo created an urban advantage, that other cities in New York did not have. The purpose of reviewing literature on the economic history of Buffalo, is also in order to understand the labor

[4] HOLC Redlining in New Deal America
https://dsl.richmond.edu/panorama/redlining/

market and housing of African Americans. During the 1940's, as said by LaChuisa, "A large number of African Americans move to the city [in this time] to work in war industries, but they will suffer more than any other group from Buffalo's subsequent decline." (LaChuisa)

Krieg also points out in this work, that African Americans were able to get jobs, that were once restricted to them. These occupations were once held mostly by the Irish and German immigrants during the 20th century. When it comes to housing, "company towns" were designated for the European workers. Krieg (2005 p.203) states, "Most of the city's African American population lived near downtown, several miles north of the steel mills. Distance alone blocked African Americans from working in the mills, and those who did were generally excluded from steelworkers' unions. At times, as in the steelworker strike of 1919, African Americans from other parts of the country were hired to work in Buffalo, only later to find that their jobs were to act as scabs in the steel mills to help management break strikes. The combined effect of these events confined African Americans to a specific geographic region of the city—a region removed from jobs in the mills to the south".

In his research of Buffalo, Krieg (2005) says, The construction of the Erie Canal was vital to the economy of Buffalo, because traveling through Lake Ontario via the Niagara River was made impossible because of the Niagara Falls (Krieg 2005).

"The construction of railroads accelerated the demise of the Erie Canal, and by the 1850 s the canal was considered largely inefficient compared to rail. As rail travel increasingly dominated transportational infrastructure, Buffalo was bypassed as a

commercial center, and its economy began to transform into an industrial,manufacturing base. The local economy shifted from one that moved commodities to one that produced commodities". Krieg (2007 p. 202)

Krieg (2005) has also found demographic data on Buffalo, that allows a better understanding of Buffalo's history. "According to the 1950 U.S. Census (U.S. Bureau of the Census 1998), Buffalo was the 15th largest city in the United States with a population of 580,132. By 2000 the population had shrunk to 292,648, a 49.6% loss (U.S. Bureau of the Census 2000)" (Krieg 2005 p. 202). This information may lead us to think, what were the reasons for this drastic change and what does this have to do with segregation? Although the existence of residential segregation tends to be a common opinion of the city of Buffalo, Trudeau (2006) says that segregation has been a choice that the African American communities have chosen to continue to live this way. To be more specific, he says, it has worked in their favor because the strategies that best fit their survival in the center of cities, is because of their social networks and where other Black people live. Trudeau (2006 p. 20), says that African Americans live in residential segregation because of three main reasons.

"(1) segregation is a result of economic differences; (2) segregation is the outcome of racial discrimination; (3) segregation is the expression of people's singular preference to live among their own race—that is, segregation is a voluntary phenomenon".

Trudeau (2006) says, that although African-Americans continue to live in such neighborhoods, and in particular in inner-cities, White flight has contributed to the

paradigm. To add to this equation, Trudeau also says that low-income minority groups have a greater desire to have the freedom of choice when it comes to housing decisions, and that the tendency to live within their own race is lesser so. In other words, social mobility has a lot to do with spatial mobility. This idea has been central to this research.

As shown in Figure 2, the largest number of African Americans are located in the northeast part of the city.

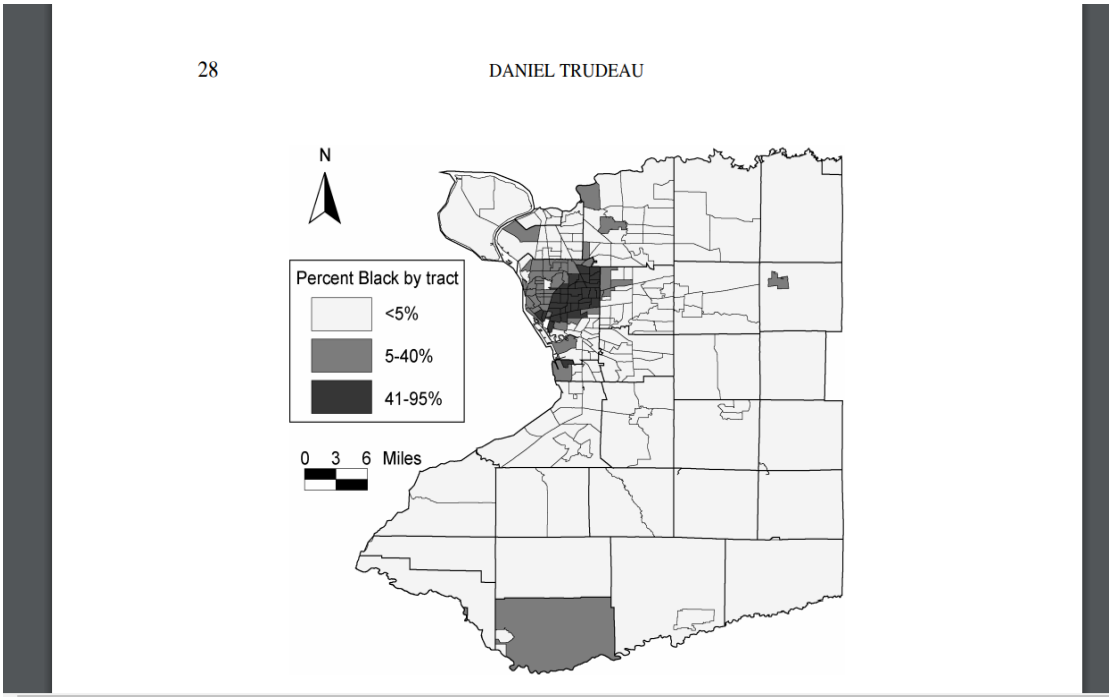


Figure 2. The concentration of Blacks in Erie County by tract, where as the darkest shades show the largest population percentage in the central city of Buffalo. "Used with permission". (Trudeau 2006. p. 28)

2.2. Demographic, Asthma, Facility Data, Redlined maps data Demographic & Asthma Data

In this study, secondary data from the U.S. census was obtained, specifically the 2017 ACS data. Minority/Race was also obtained from Census data 2017.
Asthma hospital discharge rates are per 10,000 and they are by zipcode, by the NewYork State Department of Health, for the years 2012-2014, between the ages of 18 and 64. The NYSDOH also stated that due to confidentiality, populations with small counts were not shown (excluded were hospital discharges that were less than six counts).

III. FACILITY DATA

U.S. EPA's TRI explorer (U.S. EPA 2017) data was used . Among the chemicals listed were Sulfuric acid, Ethylene Glycol, Nitrate compounds, Benzene, Cyclohexane and Glycol Ethers.

The data provided is titled, "TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), for all 59 facilities, for facilities in All Industries, for All chemicals, Erie County, New York, 2017". The EPA-TRI website shows that certain industries must report to the EPA. "TRI-Covered Industries"[5] They have been categorized by NAICS codes.

212 Mining

221 Utilities

31 - 33 Manufacturing

All Other Miscellaneous Manufacturing (includes 1119, 1133, 2111, 4883, 5417, 8114)

424 Merchant Wholesalers, Non-durable Goods

425 Wholesale Electronic Markets and Agents Brokers

511, 512, 519 Publishing

562 Hazardous Waste

On this this list, construction (NAICS code: sector 23) is not listed. For this reason, I will also look at non-reporting facilities, such as construction, that are not required to report. This information has been gathered by the Buffalo city local directory. [6] This adds 37 facilities to my research. Table provided below lists the non-reporting as well as reported facilities.

[5] TRI-Covered Industry Sectors
NAICS Codes and Toxics Release Inventory (TRI) Reporting
<https://www.epa.gov/toxics-release-inventory-tri-program/tri-covered-industry-sectors> Accessed March 2019

[6] Marketing directory Buffalo, NY.
https://www.buffalofirst.org/directory

In the following maps, TRI facilities data of locations in Erie county that was available on the EPA TRI database were joined with ZCTA shape file, which was taken from the Census Bureau. The ACS data available on the Census Bureau website was also obtained for Race in the year 2017 individuals below poverty. Individuals below poverty were then divided by the total population.

The optimized Hot Spot Analysis as stated by ArcGis website says,

"The Optimized Hot Spot Analysis tool interrogates your data to automatically select parameter settings that will optimize your hot spot results. It will aggregate incident data, select an appropriate scale of analysis, and adjust results for multiple testing and spatial dependence. The parameter options it selects are written as messages, and these may help you refine your parameter choices when you use this tool. This tool gives you full control and flexibility over your parameter setting".

In the attributes table, we can see that the optimized hotspot analysis shows the GiBin from -3 to +3. One of the strong points for using optimized hotspot analysis is that some biases such as aggregating TRI facility locations to polygons, (ZCTAs). This would create problems, where we would see TRI facilities have more locations in larger areas. There would be uneven distribution, as some ZCTAs are larger than others.

IV. REDLINED MAPS DATA

The redlined maps that were originally created by the HOLC, were then used [7]. After investigating many urban areas in New York State, I had decided to focus this study on Buffalo, New York, because other urban areas did not have significant minority population, especially the African American population. The documentation on demographics also created by the HOLC, are provided here. This documentation allowed me to see the population of African Americans and other minorities that resided in the specified "districts". The color coded map shows which areas were categorized as "Best" areas of living, shown in green, blue areas that were categorized as "still desirable"

(second best), Areas of yellow, categorized as "definitely declining", which means that these areas were seen as areas that had little to no potential of economic

success, as well as neighborhoods that saw an influx of minority populations residing there, and white flight taking place at a larger scale. The least desirable areas (as well as the least ranked) are categorized as "hazardous", although we can see a substantial number of minorities living in these areas.

[7] Environmental Justice-----Red lining in New deal America-
https://dsl.richmond.edu/panorama/redlining/#loc=11/42.7420/-73.8305&opacity=0.74

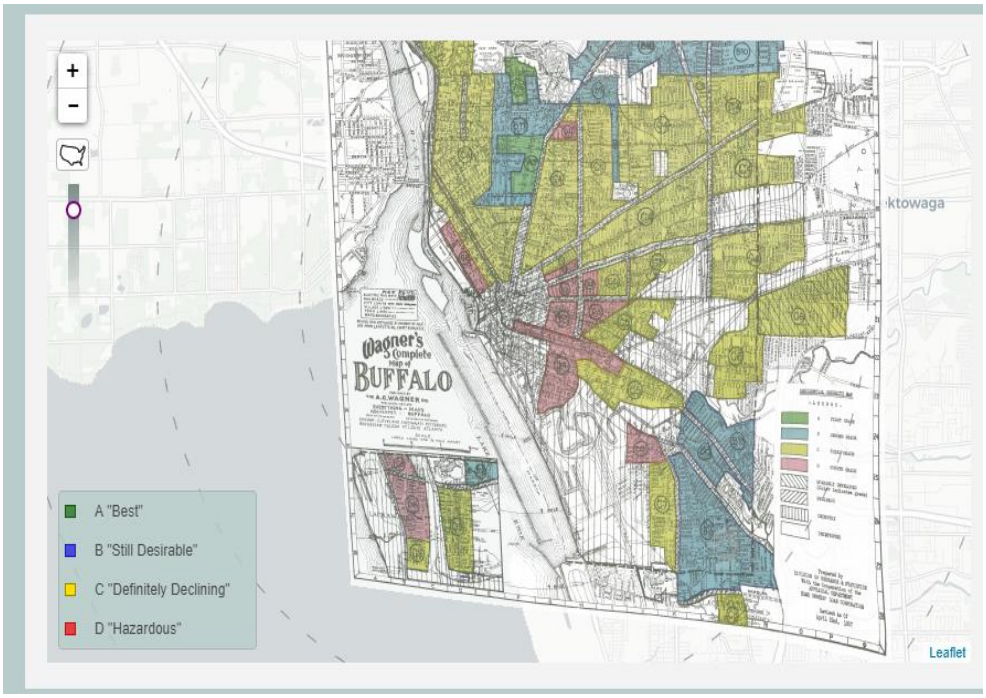
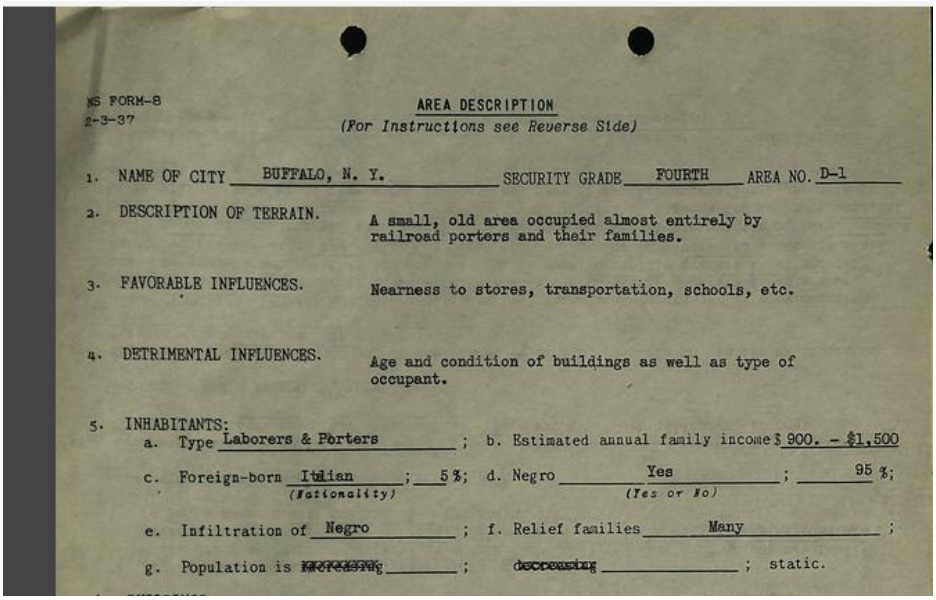


Figure 3.0. This map was created by the HOLC, and shows regions of the city that were categorized in to many sections, with influential areas labeled as “Best” and the least ranked area as “hazardous”.



NS FORM-8
2-3-37

AREA DESCRIPTION
(For Instructions see Reverse Side)

1. NAME OF CITY BUFFALO, N. Y. SECURITY GRADE FOURTH AREA NO. D-1

2. DESCRIPTION OF TERRAIN. A small, old area occupied almost entirely by railroad porters and their families.

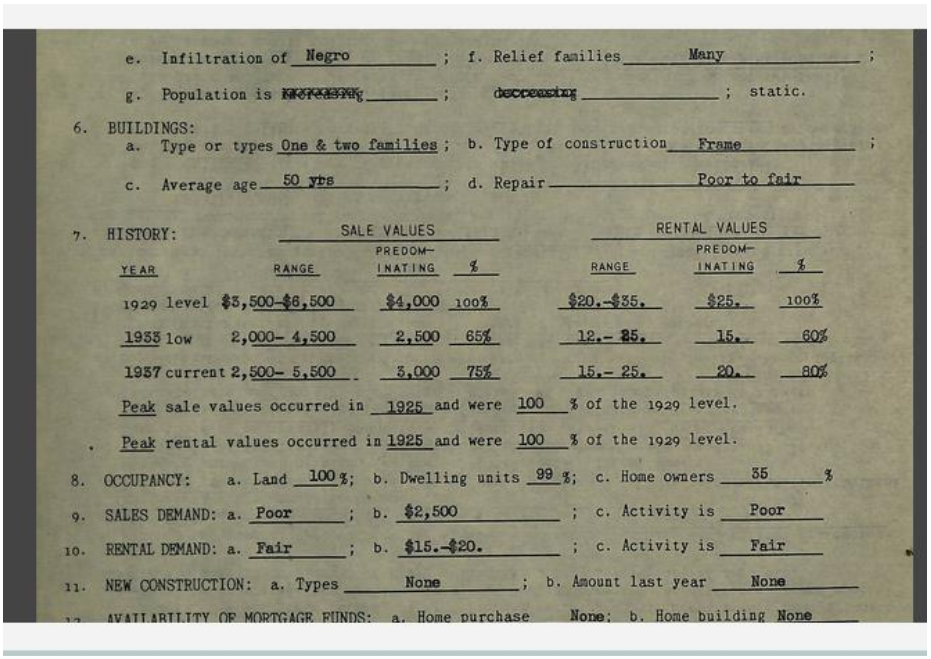
3. FAVORABLE INFLUENCES. Nearness to stores, transportation, schools, etc.

4. DETRIMENTAL INFLUENCES. Age and condition of buildings as well as type of occupant.

5. INHABITANTS:
a. Type Laborers & Porters ; b. Estimated annual family income $ 900. - $1,500
c. Foreign-born Italian (Nationality) ; 5 %; d. Negro Yes (Yes or No) ; 95 %;
e. Infiltration of Negro ; f. Relief families Many ;
g. Population is ~~increasing~~ ; ~~decreasing~~ ; static.

Figure 3.2. (pic 1 of 3) HOLC document of redlining (Mapping Inequality. Redlining in New Deal America).[8]

[8] Maping Inequality. Redlining in New Deal America.
< https://dsl.richmond.edu/panorama/redlining/> Accessed April 2019



e. Infiltration of Negro ; f. Relief families Many ;

g. Population is ~~increasing~~ ; ~~decreasing~~ ; static.

6. BUILDINGS:
a. Type or types One & two families ; b. Type of construction Frame ;

c. Average age 50 yrs ; d. Repair Poor to fair

7. HISTORY:

	SALE VALUES			RENTAL VALUES		
YEAR	RANGE	PREDOMINATING	%	RANGE	PREDOMINATING	%
1929 level	$3,500-$6,500	$4,000	100%	$20.-$35.	$25.	100%
1933 low	2,000- 4,500	2,500	65%	12.- 25.	15.	60%
1937 current	2,500- 5,500	3,000	75%	15.- 25.	20.	80%

Peak sale values occurred in 1925 and were 100 % of the 1929 level.

Peak rental values occurred in 1925 and were 100 % of the 1929 level.

8. OCCUPANCY: a. Land 100 %; b. Dwelling units 99 %; c. Home owners 55 %

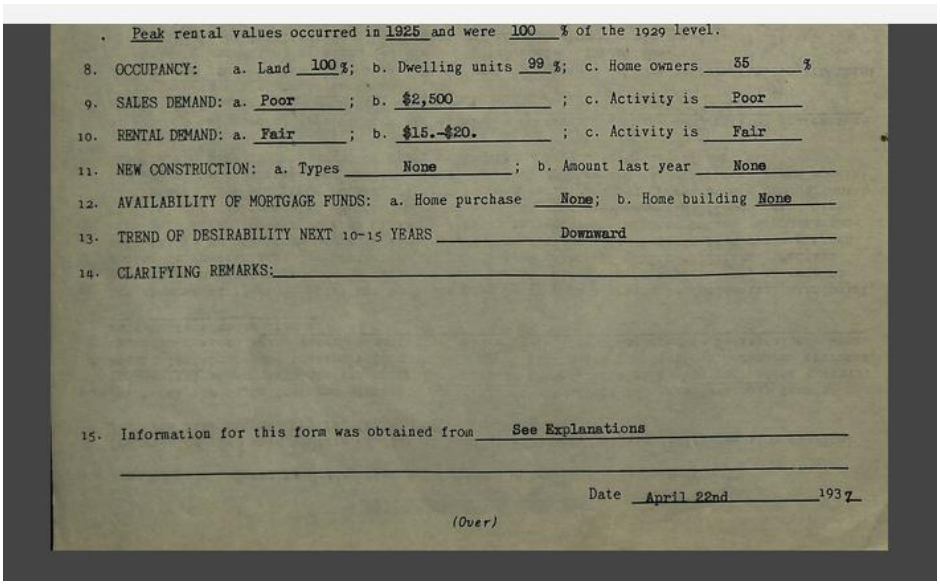
9. SALES DEMAND: a. Poor ; b. $2,500 ; c. Activity is Poor

10. RENTAL DEMAND: a. Fair ; b. $15.-$20. ; c. Activity is Fair

11. NEW CONSTRUCTION: a. Types None ; b. Amount last year None

12. AVAILABILITY OF MORTGAGE FUNDS: a. Home purchase None; b. Home building None

Figure 3.2. (pic. 2 of 3) HOLC document of redlining



. Peak rental values occurred in 1925 and were 100 % of the 1929 level.

8. OCCUPANCY: a. Land 100 %; b. Dwelling units 99 %; c. Home owners 55 %

9. SALES DEMAND: a. Poor ; b. $2,500 ; c. Activity is Poor

10. RENTAL DEMAND: a. Fair ; b. $15.-$20. ; c. Activity is Fair

11. NEW CONSTRUCTION: a. Types None ; b. Amount last year None

12. AVAILABILITY OF MORTGAGE FUNDS: a. Home purchase None; b. Home building None

13. TREND OF DESIRABILITY NEXT 10-15 YEARS Downward

14. CLARIFYING REMARKS:

15. Information for this form was obtained from See Explanations

Date April 22nd 1937

(Over)

Figure 3.2 (pic. 3 of 3) HOLC document of redlining

We can learn a lot from these documents created by the HOLC. As an example here, District 1, also written here as “D-1”, shows that 95% of people living in this area were African Americans, and 5% were Italians. The occupations listed are “laborers and porters”. “Porters” was the term to describe railroad employees who aided passengers, and their luggage to and from the trains. The people who resided in District 1 had an average family annual income of $900- $1500. This document also shows that the “Availability of Mortgage Funds” were listed as “none”. The number of homeowners is 35%. Another category stated here is “Trend of Desirability in the next 10-15 years”, in which the document has listed this district as “downward”. This label may have prevented influential people, including those with a stable income to reside in this area.

Compared to areas represented in the color of red “Hazardous”, areas of green were synonymous with the word, “Best”. One example here is the district labeled as “A-2” (not shown). The estimated family income in $6,000 and up. The people here are described as non-foreign born. The document also states that there are “No Negroes” in the area residing there with a percentage of “0%”. Furthermore, this area has been listed as “Single Family Homes” and that there is “No Rental Area”. The number of homeowners in this area is “95%”. The inhabitants in this area have been stated as “Bus. and Professional Men”. Some green categorized areas such as “A-6” have an annual income of “$20,000 and Up”.

Today these areas continue to have affluent people residing here, and there continues to be a White majority population that is living here. One reason for the demographics to be the same can be because of inheritance wealth and assets that the White majority population may have benefitted from. Intergenerational wealth has allowed Caucasians to have an economic advantage (Avery and Rendall 2002). The Black-White racial wealth gap continues to have effects today. Studies such as Avery and Rendall (2002) have shown that this advantage allows for security, and easier social mobility. Included in this equation are the entrepreneurs and business owners that are self-employed and are able to pass down their businesses to their offspring’s. An important claim that Avery and Rendall (2002) point out is that even today, the Black population that are self-employed are fewer in numbers. The documents show that the majority of homes are “Single Family Homes”, which shows inheritance of property that contributes to wealth, and the future generations that can inherit this property.

Chapter 3. Results Mapping the Data:

In this section I will be mapping the data that was taken from the U.S. Census Bureau, the New York State Department of Health, and the TRI data that was taken from the EPA website. The choropleth maps allow us to see the varying ranges of median income and population counts. The other choropleth maps here allow us to distinguish the majority populations.

The purpose of the Hot Spot analysis maps are to show which areas are statistically significant when it comes to the locations of TRI facilities, simultaneously the asthma counts are also displayed on these maps represented with graduated symbols which show the greater rates of asthma with larger shaped circles, whereas smaller rates of asthma are represented with smaller circles. Visually, this allows us to compare areas that are significant hot spots with the rates of asthma and see if a pattern exists. The findings based on these maps will be included in the following discussion section, following the end of this chapter.

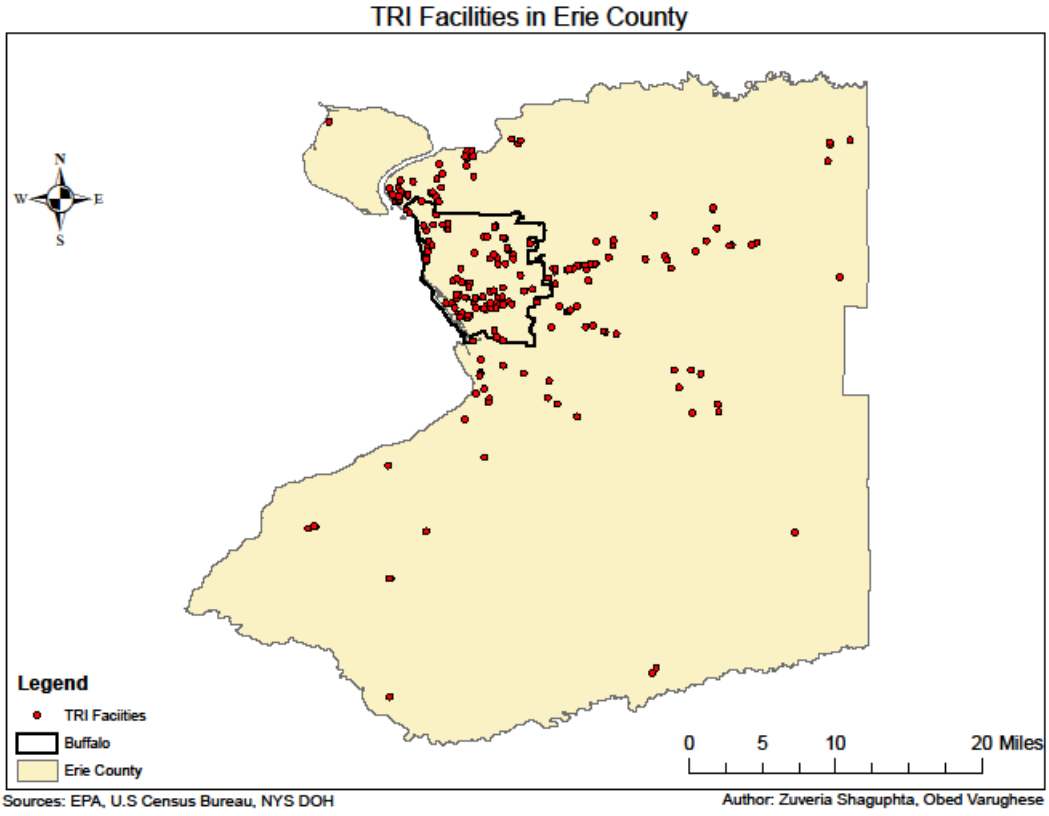


Figure 4. TRI facilities in Erie County Map.

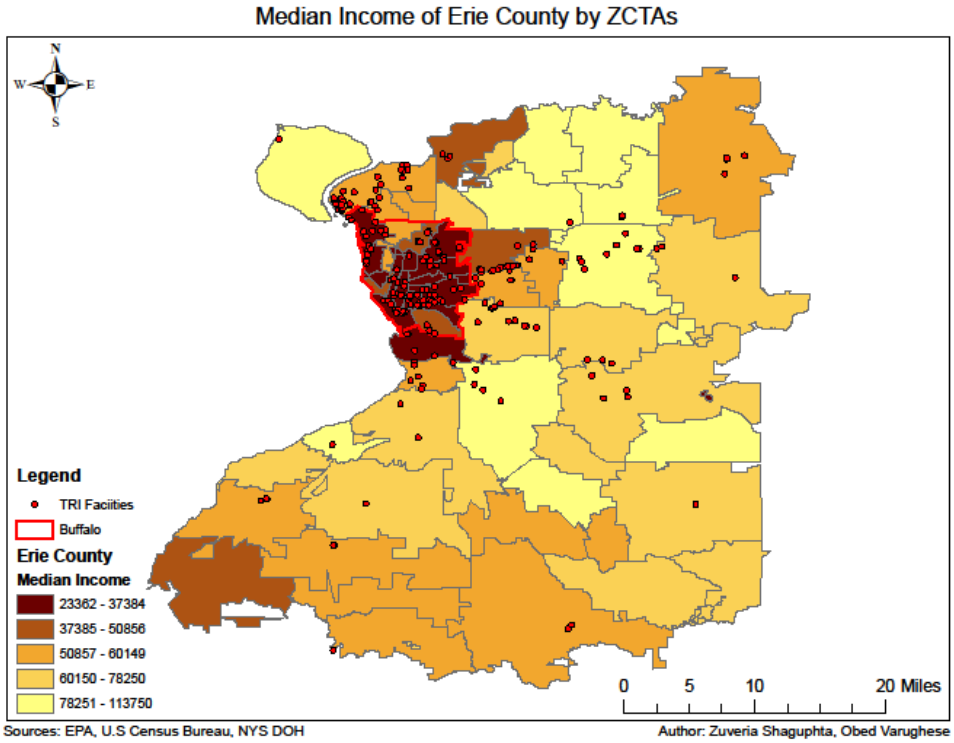


Figure 5. Choropleth map showing median income of Erie County. The City of Buffalo has the lowest median income, represented here in the darkest shade.

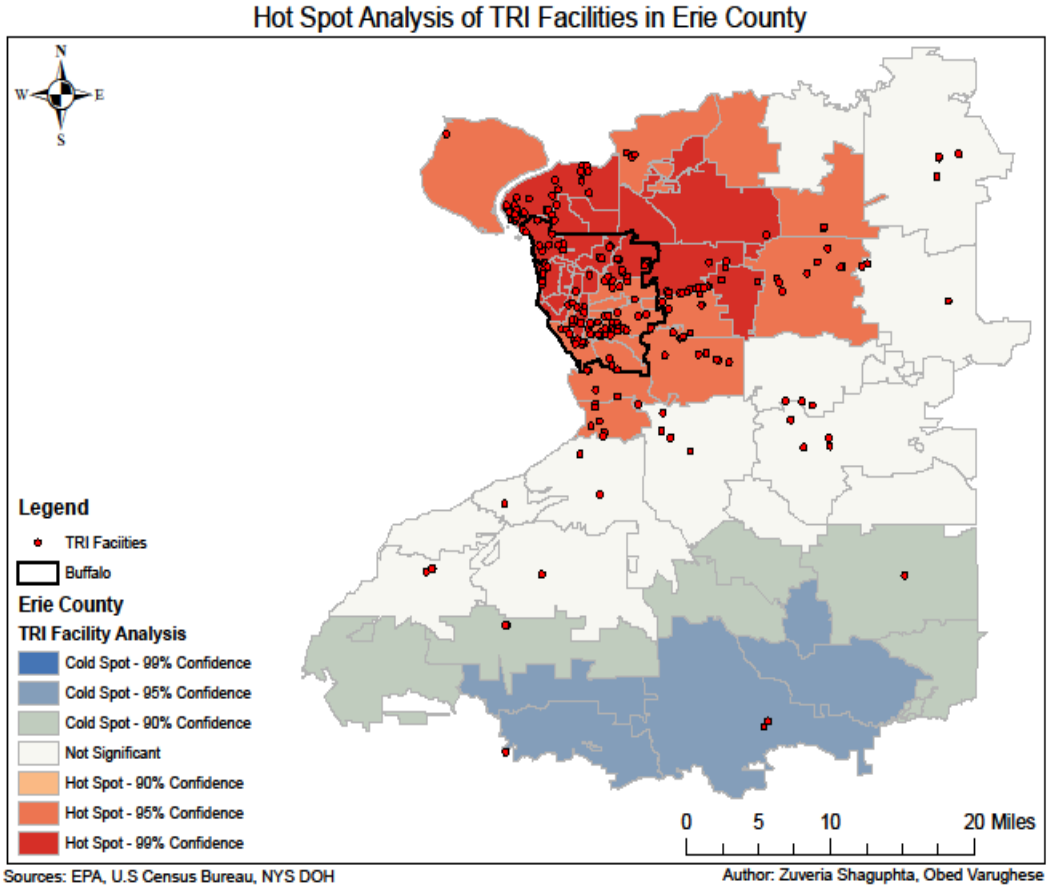


Figure 6. Hotspot Analysis map of Erie County shows that Buffalo and the outskirts of the city, are areas of statistically significant when it comes to TRI facilities siting.

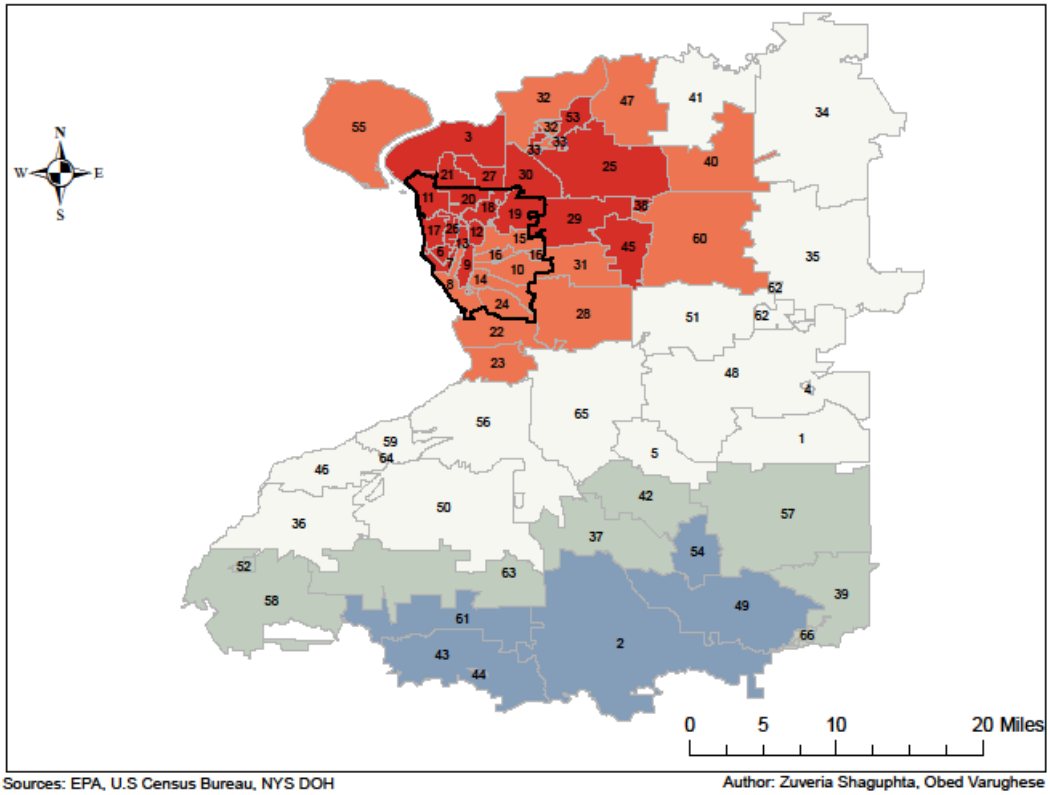


Figure 7. (Reference map for fig. 6)

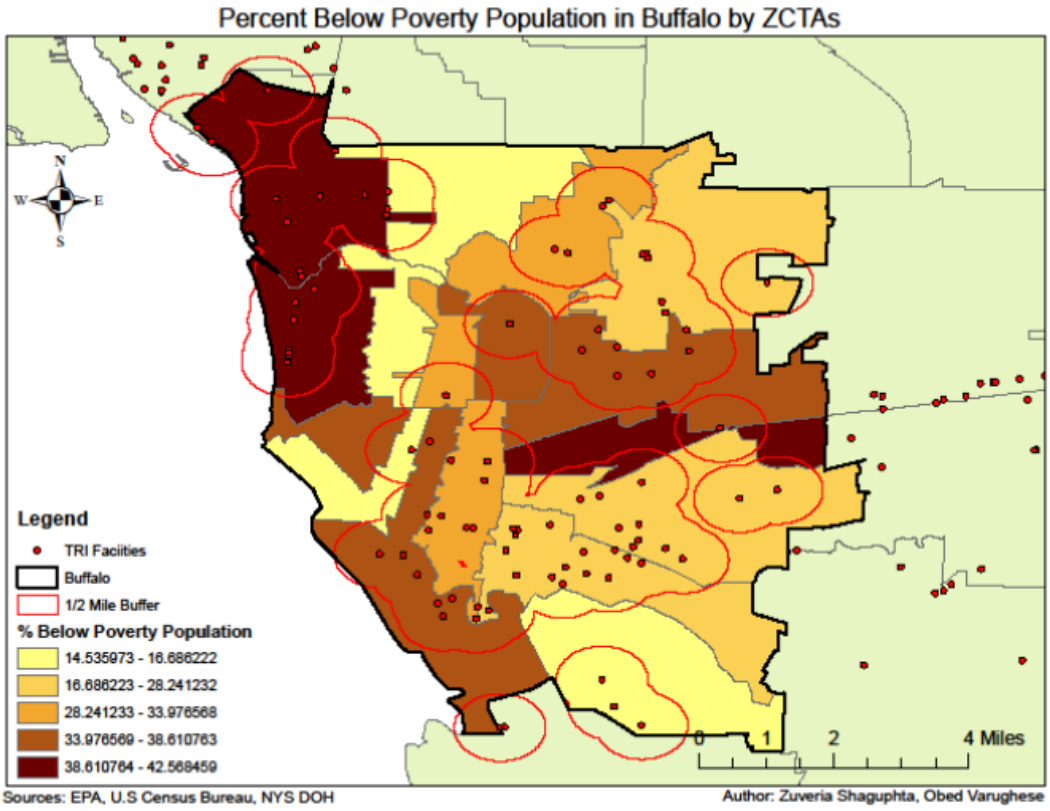


Figure 8. The choropleth map (fig. 8) shows the largest percent below poverty in two main areas, where 38-42% of the population are living in poverty.

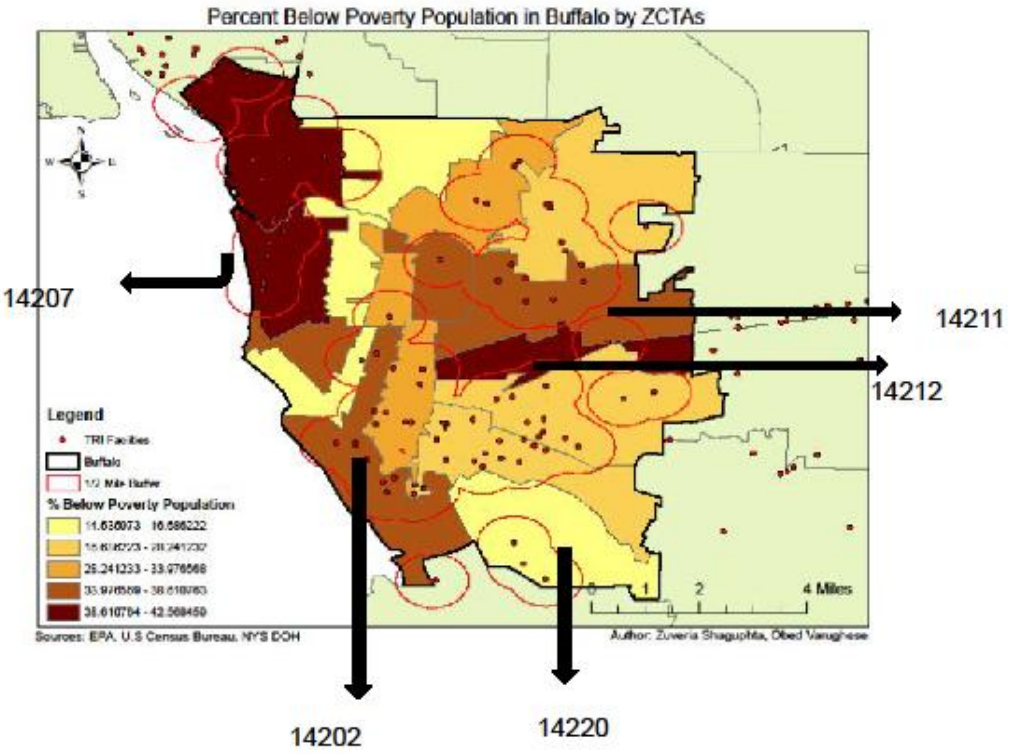


Figure 8.1. Reference Map for Figure 9. The purpose of this map is to highlight zipcodes that are most relevant to this research. Zipcode 14220 for example has the least percentage below poverty 11-16%. Zipcodes 14207 and 14212 have the highest below poverty with 38-42% that are below poverty.

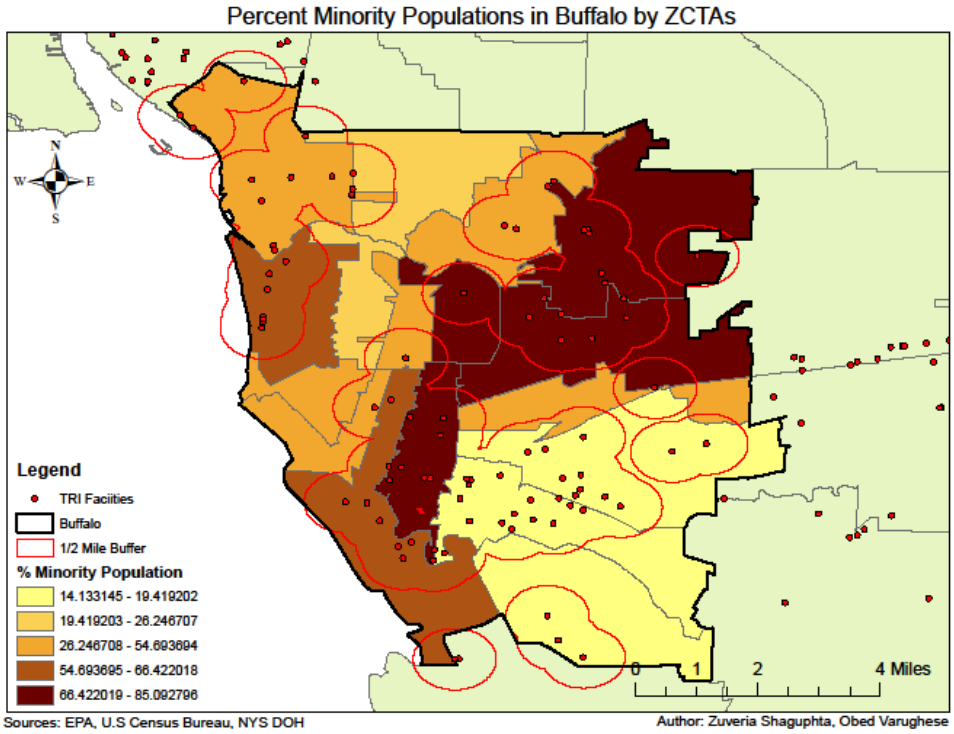


Figure 9. In this figure, polygons also shown by ZCTAs shows where the least minority population lives. We can see here, the yellow region represents this region.

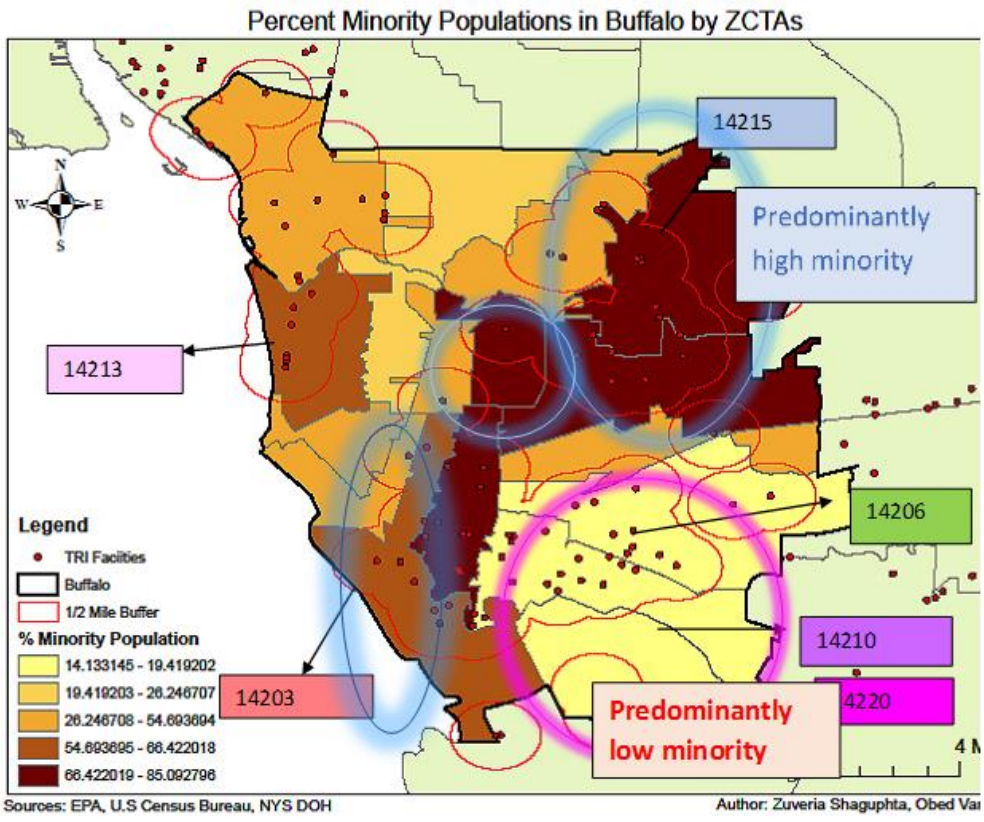


Figure 9.1. (Reference map for fig. 9.)

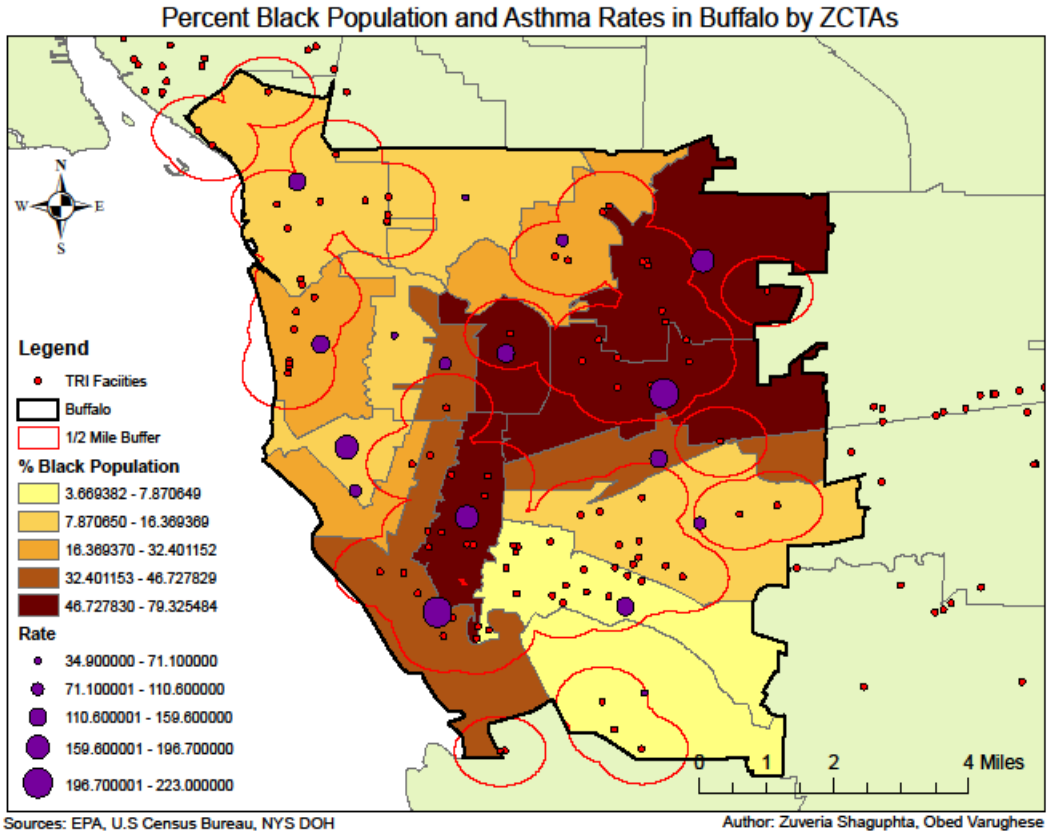


Figure 10.1 In this choropleth map, we can see that 47-79% of the Black population are located in the central and north east of the city.

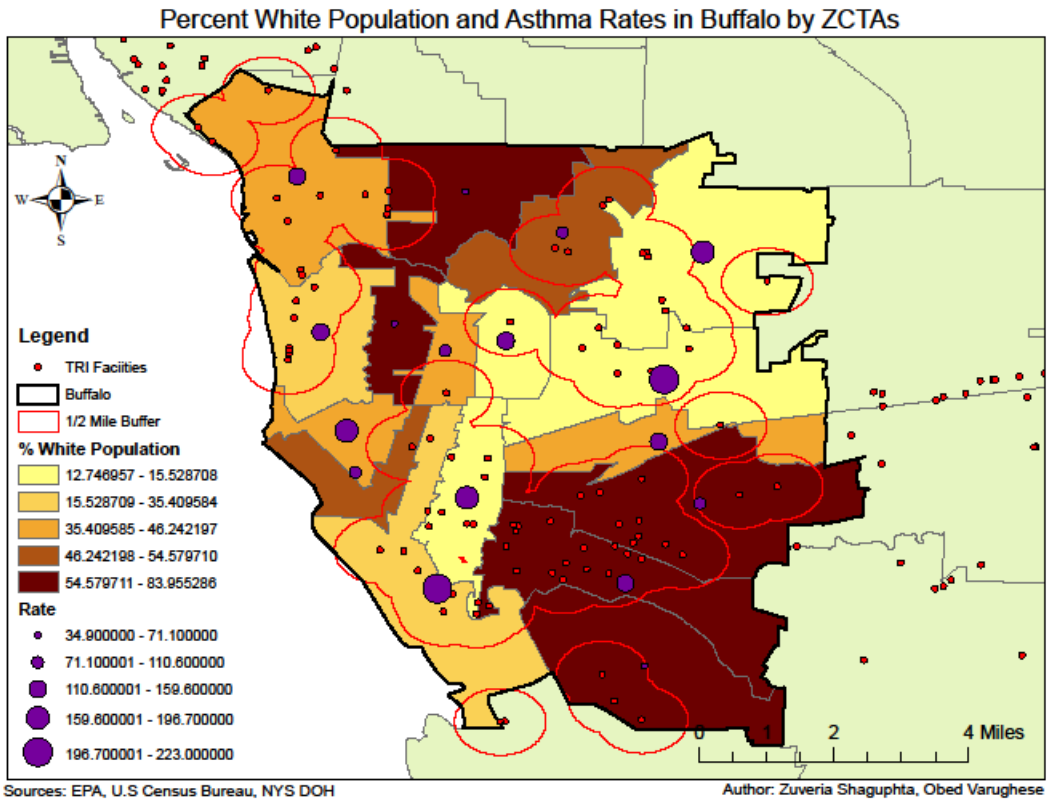


Figure 10.2 54-83% of the White population of Buffalo are located in the north and southeast part of the city. The asthma rates per 10,000 individuals is also low, not exceeding more than 160 per 10,000 individuals.

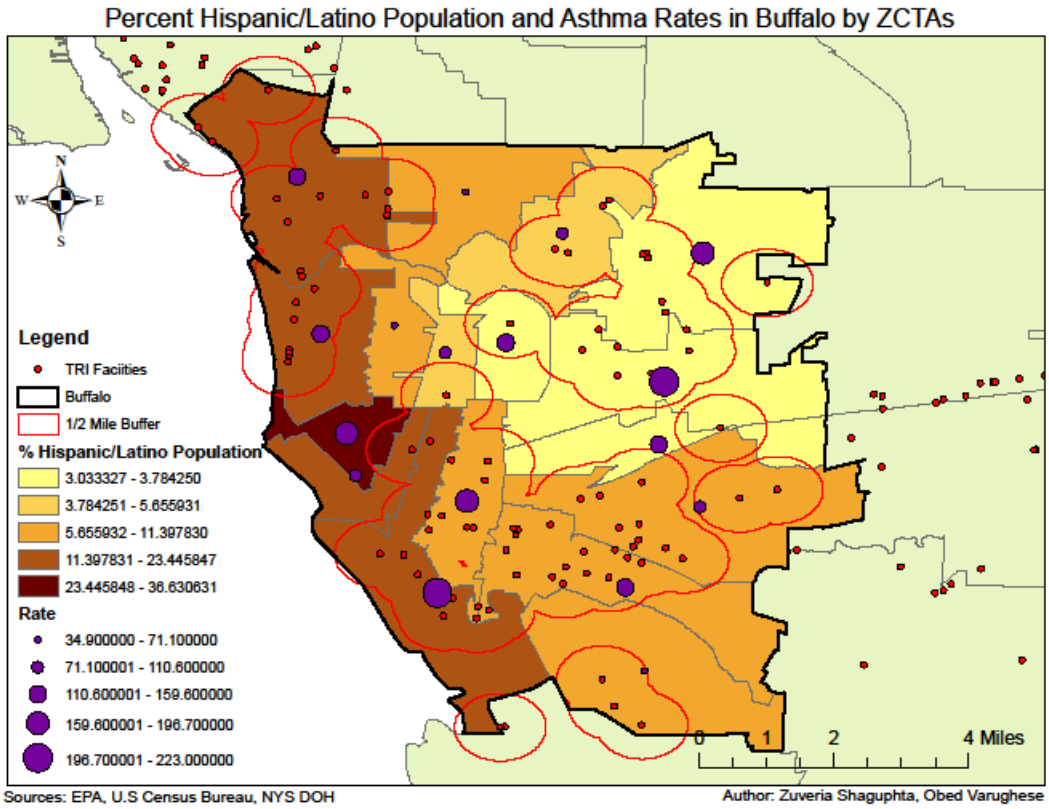


Figure 10.3. The Hispanic population is low in Buffalo, we can see the zipcode with the highest percent consists of 23-37% of this population.

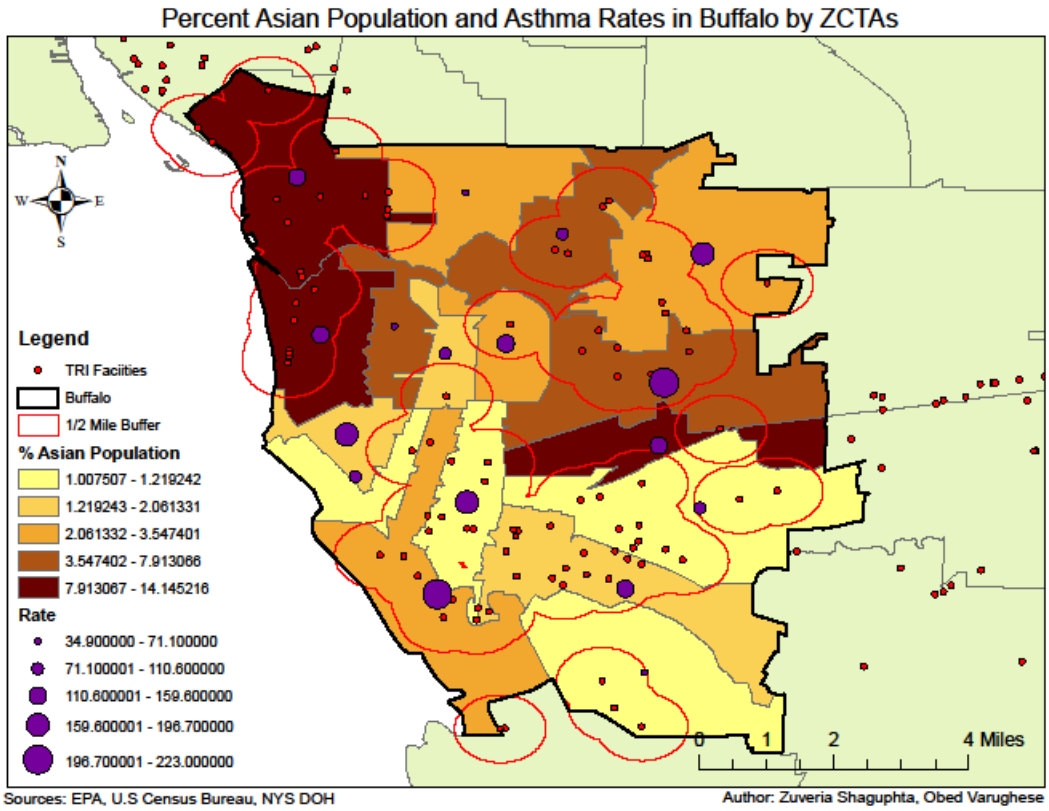


Figure 10.4. We can see that the Asian population in Buffalo, N.Y. is small.

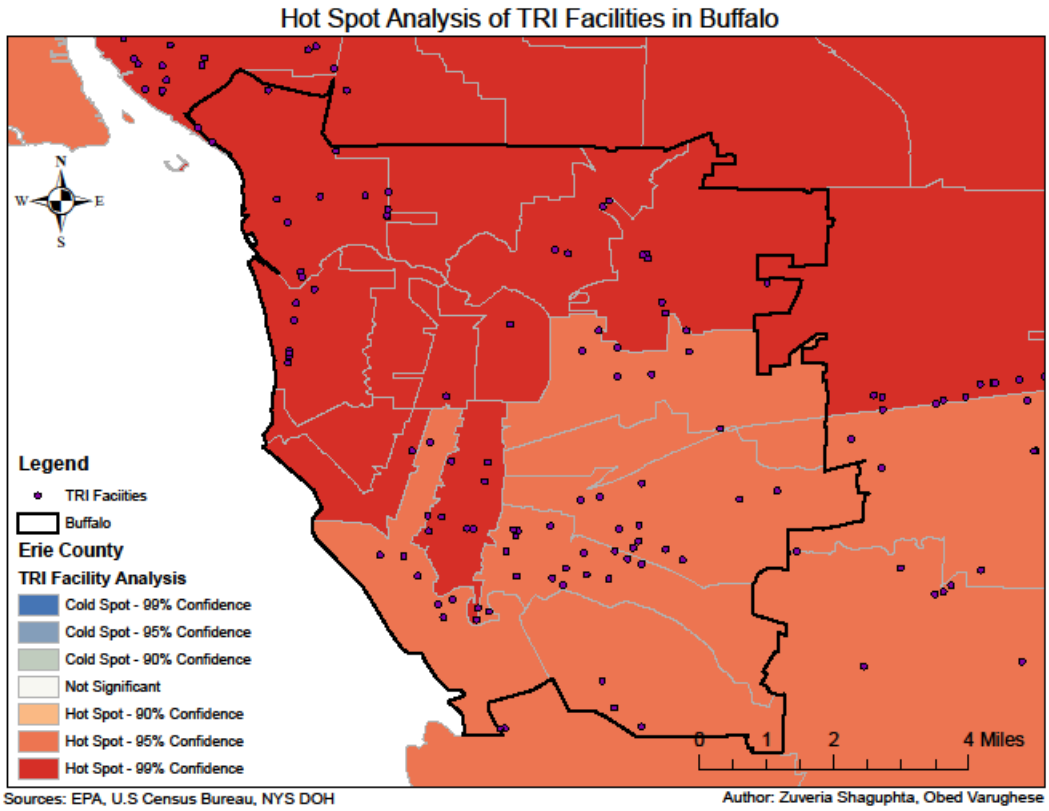
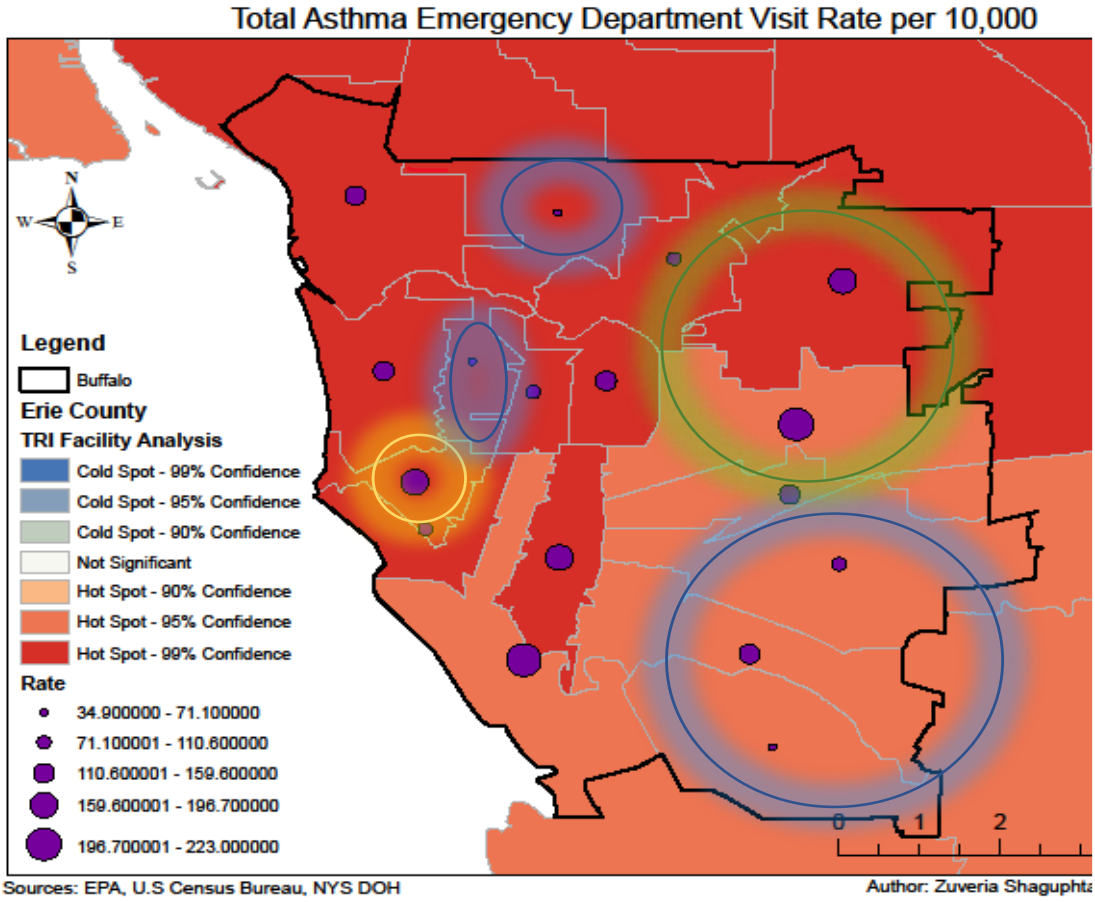


Figure 11. This map shows the TRI facilities represented as small purple dots, they are scattered across Buffalo. Without the Hotspot analysis we would not be able to see which areas have significantly higher and lower confidence intervals.



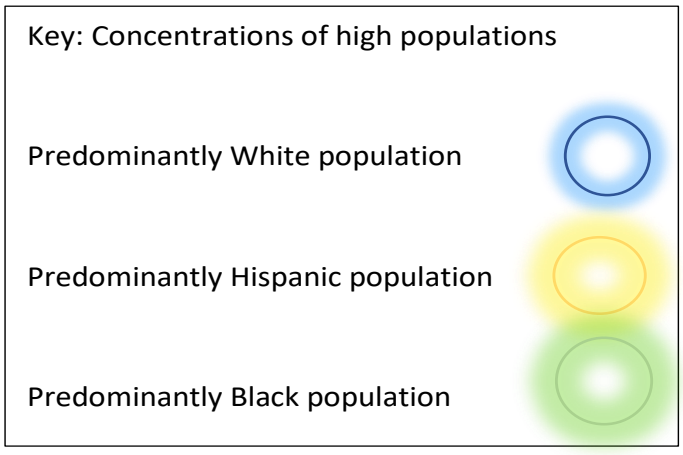
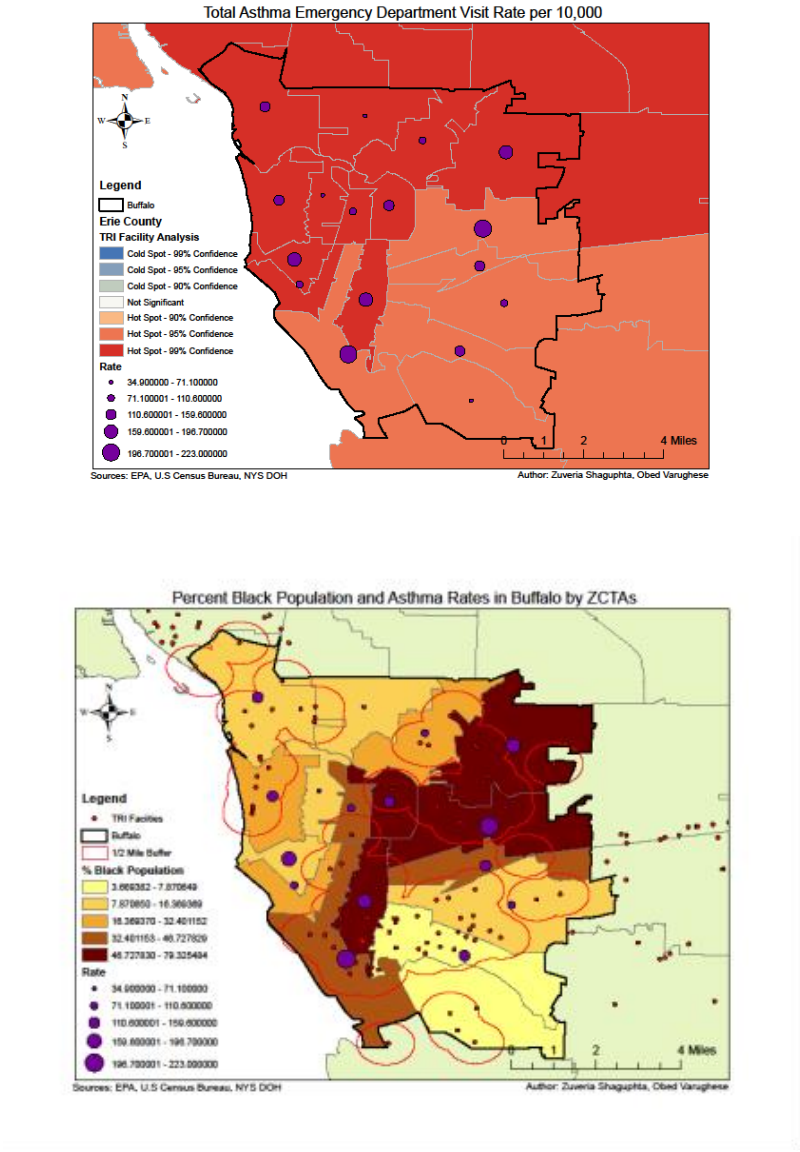
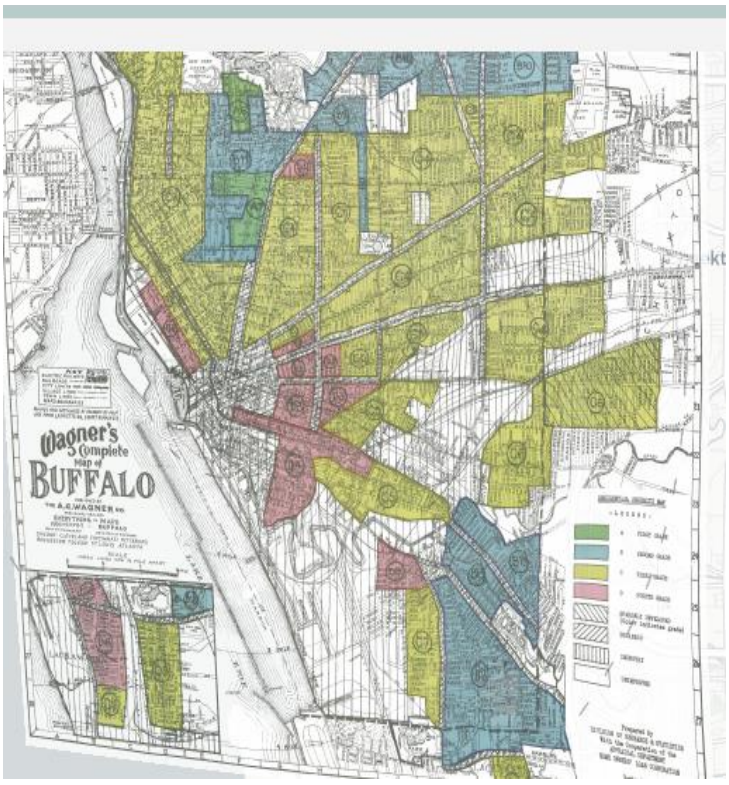


Figure 11.1. The purpose of this map is to highlight which areas of Buffalo had higher populations of the different races and pointing out which areas have higher rates of asthma represented with the purple circles.



.

Figure 12. Total Asthma Emergency Department Rate Visit per 10,000 individuals and Hotspot Analysis



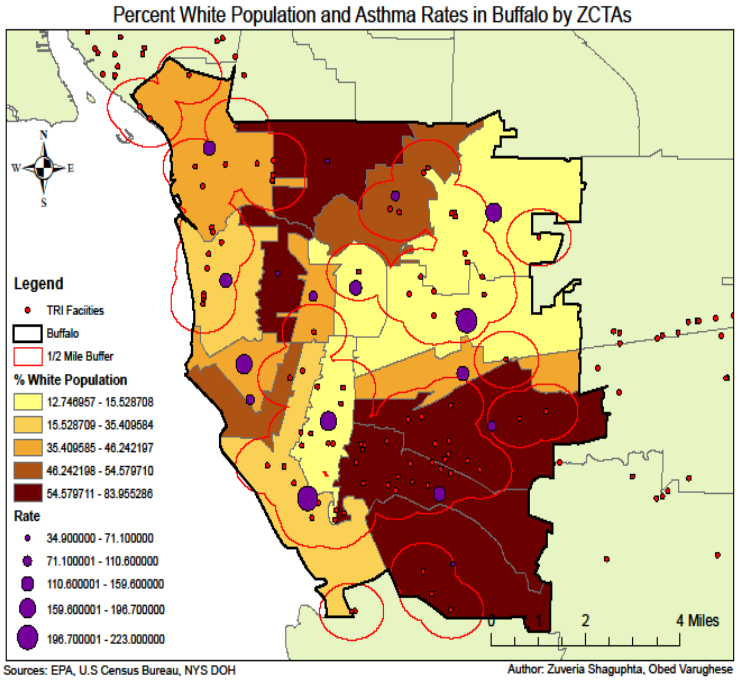


Figure 13. The purpose of displaying these maps together is to show the areas that were once redlined and areas that were suited as "Best". We can still see that a

White majority lives in the same areas of green and blue from the HOLC map. The White population is living in areas of Hotspots in regards to TRI facilities. areas that were designated as blue and green , “Best” and “Still Desirable”, in the HOLC map. With the population being 50-80% of the White population. The Black population consisting of 48-79% is living in areas that were designated as “Declining” and “Hazardous”, in the HOLC map these areas are color coded in yellow and red.

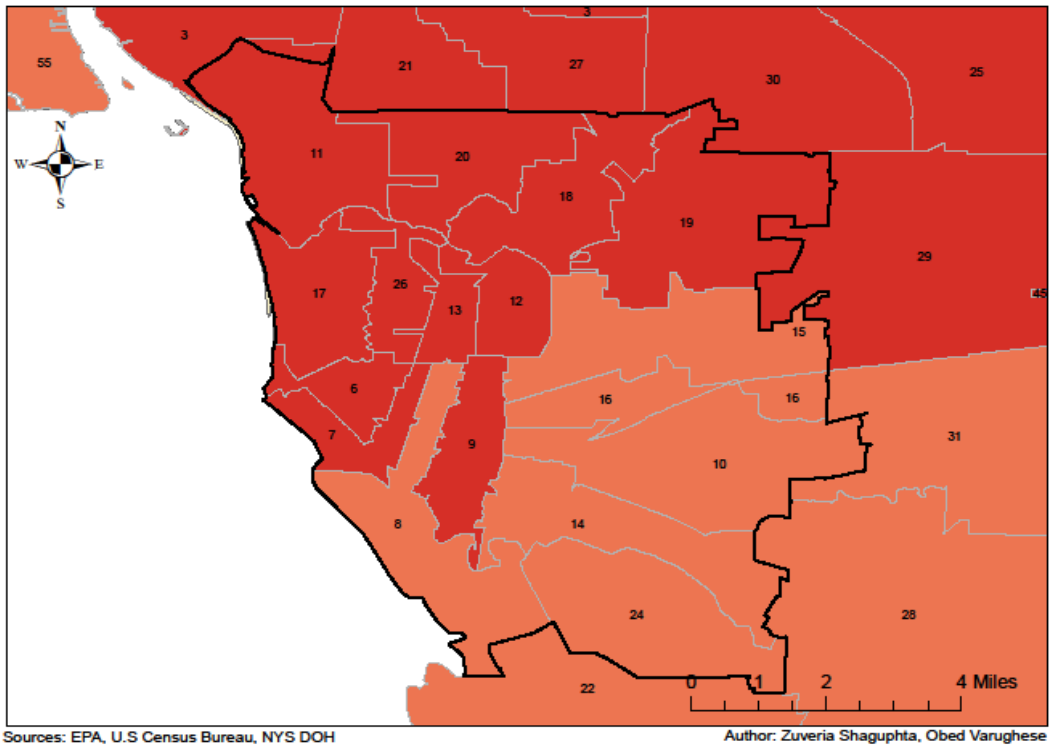


Figure 14. (Reference map for Hotspot analysis maps.)

Summary of Results:

The premise of this paper, and the main findings support previous studies that followed the idea of health burdens being greater in predominantly minority communities, specifically African American and Hispanic communities in the United States. Studies have also showed that health burdens are greater in poor neighborhoods. The map of median income of Erie County by ZCTAs (figure 5) shows that Buffalo has the lowest median income of about $23,000-$37,000. In the hotspot maps (figure 11 and 11.1) , Northern part of Buffalo shows the highest confidence interval of 99%, which means that there is a statistically significant higher amounts of TRI facilities located in these ZCTAs compared to the rest of Buffalo. The bottom half of Buffalo, as seen on the map, still shows a significant concentration with the hotspot showing a 95% confidence level. The cold spot shown in blue in figure 6, is located in the south part of Erie County. The percent below poverty population map of Buffalo (also by ZCTAs) shows that ZCTA and Zipcode 14207 and 14211 have the largest percent below poverty which is 38-42%. My hypothesis supports existing literature on environmental justice in poor and minority communities, and specifically predominant African American and Hispanic communities. The hotspot analysis allowed us to find areas of statistically significant concentrations of TRI facilities. Although I can not conclude that this hotspot analysis necessarily means that there is a direct causation with asthma rates and toxic release

inventory facilities. Further research can use regression to test relationships of location siting of TRI facilities and asthma prevalence.

Chapter 4 Discussion and Findings:

Previous studies have found environmental health burdens affect certain populations disproportionately more than others. Populations that fit in this category are more likely minorities and have low-income. There are many variables that also play a role in these health disparities, which include access to healthcare, awareness and educational attainment, as well as living in inadequate housing among others. Exposure to chemicals, indoor and outdoor may also affect respiratory health and other ailments.

Communities that live in close proximities to polluting facilities have greater occurrences of asthma and other ailments such as cancers. Environmental justice studies have focused attention on these unintended consequences. As reviewed in this paper, residential proximities to freeways has also been an area of concern, as well as traffic related asthma exacerbations. According to the U.S. Census Bureau the median income of the city of Buffalo is $34,000 and a population of 268,212. This map (fig. 5) shows us that the largest cluster of TRI facilities are located in the area of lowest median income, shown here in the darkest brown color. The outer area of (zip codes) brighter yellow, show the highest median income in the city of Buffalo of about $75,000 to about $105,000. The literature review provided here, also follows the same paradigm, that

people of low socioeconomic standing carry a larger burden of having toxic release inventory facilities located near them.

The red dotted clusters represent TRI facilities. We can see that the largest clusters are in the north east part of Erie County, Buffalo, NY, while they are more dispersed throughout the rest of Erie County. They become even more unevenly spaced out near the boundary of Erie County. This has to do with Buffalo, New York being a commercial center and the most populous metropolitan area in Erie County.

In this paper I have found that the effects of redlining during the New Deal era has continued to be in existence nearly eighty years from its formation. This intentional and institutional form of segregation has been supported in this study, as we can see that the majority of African American populations continue to live in certain regions of the city of Buffalo, and the same goes for predominantly White populations. This map (figure 10.1) Shows us the that the largest population of African Americans (Blacks) are located north east and central, forming a contiguous area. The zipcodes in this predominantly Black population are 14215, 14204, 14211, and 14212. Furthermore, when the asthma rate is observed, we can see that the ZCTAs of the darkest brown region, also have the highest rates. Each polygon shows the asthma rates of 196-223 per 10,000 and 159-196 range. This is a noticeable difference, if we compare this to zipcodes of the predominantly White population zipcodes. In fiigure 10.3, I wanted to highlight areas where we see a high population rate of Blacks and areas where we see a low population.

The maps also show that the predominantly White zipcode tabulation areas consisting of 54%-83% of White population had the least percentage below poverty. This

map (figure 10.2) shows us the Caucasian (White) population in the darkest brown shade, the largest area, which is the south east part of the city of Buffalo. The zipcodes with predominantly White race are, 14216, 14222, 14206, and 14210. Here we can see that the asthma rate is 71-110 and 34-71 per 10,000. These are the lowest rates shown by the map. We can see a vivid contrast with these zipcode areas and asthma rates. They are drastically on the lower end.

However, the opposite could not be supported here in the maps of the African American population. We could not clearly see a pattern of less affluent zipcodes (% below poverty) with higher percentages of the population being African American and or Hispanic. The map (figure 9) shows polygons of ZCTA of Buffalo, New York, in which the percent below poverty is represented in the legend. The darkest brown shade which ranges from 38% and 42% is the percentage most below poverty. We can see with the darkest brown regions are northwest of Buffalo, New York, as well as central Buffalo.

Figure 7, 12 and 12.1 a Hot Spot Analysis was done using the NAD 1983 which measured in meters for the Getis Ord GI* hot spot analysis. An Optimized Hot Spot Analysis was the method chosen. This analysis portrays TRI facilities clusters, and the clusters will then show if the areas are statistically significant. Global Moran fishnet grid were used here, because I did not choose an analysis field, which then created a polygon grid over my points of TRI locations. This hot spot analysis allowed us to see if there are colds spots too, however the analysis didn't show huge differences in the city of Buffalo. Cold spots were however visible in the southern part of Erie county.

In many studies, segregation has been frowned upon, and often has negative connotations and invokes a sentiment of avoidance. However, some studies have found

that segregation has been a positive driver in some communities. They may argue that homogeneity has allowed communities to thrive. Sentiments of inferiority or feeling of not belonging in neighborhoods that are predominantly of a different race may become a means of staying in the neighborhood that the individual grew up in. Hence, they may feel the need to stay put in their original neighborhood.

Segregation may also cause limited social mobility, because it doesn't allow individuals to experience a good quality of life. Often times these neighborhoods have disamenities, lack of open green-spaces, access to healthy food stores and healthcare, and good education. In this circumstance, studying Buffalo, NY, we can see that institutional powers (HOLC) in redlining areas that literally showed where Blacks should live and where Whites should not live had created a barrier between the two races, and created a feeling of superiority vs. inferiority. It makes me question whether matters were worse (and how much worse) for the southern part of the United States during the New Deal period, and before the Civil Rights Movement gained momentum. Although New York City was seen as a liberal hub of ideas, and advocacy for Civil Rights was at the forefront of the city's agenda (but not until the 1960's), I don't think the same can be said for Upstate New York during this time. This region of New York is often described as being (a tiny) part of the Rust Belt region of the United States. Buffalo, New York was a city that was an economic powerhouse compared to the rest of Upstate New York in the late 30's, and may have had a different political atmosphere. The wealthy business owners and leaders may have advocated for segregation, because this allowed their properties to have an even greater value, and since segregation was seen as the norm.

When it comes to TRI facilities, the hotspot analysis showed that areas consisting of White majority populations and the amount of TRI facilities sitings had a slightly lower confidence interval of 95% compared to zipcodes with a Black majority population that had a 99% confidence interval. Fig. 11. is a map of the Hot spot Analysis and it shows where the TRI facilities are located. Two out of the five White majority zipcodes had a hotspot confidence interval of 99%. This means about 40% of the White Majority population has a significance that is higher than the Black majority population. Furthermore, predominantly White majority population zipcodes consisting of 54-83% Whites were zipcodes: 14216, 14220, 14210, 14206. They are located in the neighborhoods of North Park, Abott-McKinley, South Abott. These zipcodes also had the least percent below poverty of less than 16%. The least poverty range of 11-16% were zipcodes: 14220, 14216, 14222 and 14204. From this analysis I would assume that predominantly white majority zipcodes have the least amount of poverty populations. White majority zipcodes had an asthma rate of 56-96 per 10,000.

When we analyze the poverty percentage population map (Figure 8), the zipcodes with the most high percentage (consisting of 40%) of poverty are: 14207, 14213, and 14212, these zipcodes are located in the neighborhoods of Broadway-Fillmore, Squaw Island and Emerson. None of these zipcodes fall under the high percentage of White populations. When observing the hotspot analysis maps, two out of the three high poverty zipcodes have significance of 99% confidence interval. That means 67% of the zipcodes have this significance level of 99%. For this reason, we can not assume that poverty and TRI facility siting are directly correlated with one another. However, since it still shows an area of hotspot of 95%, more research can be conducted to further study this

relationship. The asthma rate of the zipcodes that fall under the predominantly poverty zipcodes is 110-159 per 10,000.

Black majority zipcodes consisting of 46-80% had three out of the four zipcodes with a hotspot confidence interval of 99%. That means 75% of the zipcodes have a confidence interval of 99% higher of TRI facility siting compared to the White majority zipcodes that have a 40% of their zipcodes with the same confidence interval. The average asthma rate of the predominantly Black zipcodes is 156-186 per 10,000. Compared to the White majority zipcodes that had an asthma rate of 56-96 per 10,000. We can clearly see a substantial difference in asthma rates between the predominantly White zipcodes and the predominantly Black zipcodes. A difference rate of 100-90 per 10,000 is here. The rate is doubled, if not more.

Given the results, we can see that there are differences amongst the Black and White populations. The White majority zipcodes have the least amount of poverty and when it comes to TRI facility siting in the analysis of the hotspot map, only 40% of the zipcodes have a 99% significance level, whereas the Black majority population has 75% of the zipcodes falling in this category. The asthma rate per 10,000 individuals is more than doubled. The asthma rate in predominantly minority zipcodes has the same results.

When we reflect on previous studies and literature, my results support the following claims, minorities carry a greater burden of dwelling near disamenities and the same goes for poor people, as the hotspot analysis map shows that predominantly minority zipcodes also had 75% of their zipcodes with a 99% confidence interval. African Americans have higher rates of asthma, as well as minorities. Place of residence has been pointed out as a factor relating to higher rates of asthma. Low income

neighborhoods (zipcodes), African American neighborhoods have higher rates of asthma. Since I have compared the zipcodes of White majority zipcodes and those of minorities, Blacks, Asian and Hispanic, we can see that there are vast differences and that they are visibly present in the maps. The disparities can be seen here, Fig. 10.4

The Hispanic population in Buffalo, NY is small. We can see that the most populous Hispanic zipcode is 14202. The population of Hispanic people is 23-36%, and the asthma rate here can be seen with two ranges, 159-196 and 71-110 per 10,000 individuals. The second highest percentage of the Hispanic and Latino population are on either side of the predominantly larger percentage, in which the highest rate of asthma of 196-223 per 10,000 are on the lower bottom side.

Using crime, U.S. Census and Bureau of Labor Statistic data, Chasing Chains©, real estate tool created a website called Home Snack (Kolmar, 2018), which ranks the best and worst communities across the United States. For Buffalo, New York, they have stated the worst neighborhoods to live in that are located there: Emerson (14211, 14212), Broadway-Fillmore (14206,14211,14212), Babcock (14210), South Ellicott (14204), MLK Park (14211), Squaw Island (14207), Emslie (14206), First Ward (14203), Genesee Moselle (14211), and Schiller Park (14211, 14212, 14215). The best neighborhoods to live in (they have stated) are: South Abott (14210, 14220), North Park (14216), Starin Central (14216), Albright (14222), Delaware-west Ferry (14222,14209), Parkside (14214), Abott-McKinley (14220), Forest (14221), Park Meadow (14216) and Lakeview (14201). When observing the locations of these neighborhoods, I have found in figures 9, 10.1 and 10.2 that most if not all of the “worst” neighborhoods have a predominantly

African American population and minority population, whereas the "best" neighborhoods are predominantly Caucasian majority.

One of the neighborhoods called "Squaw Island" (zipcode 14207) has been under scrutiny, as the name "Squaw" is a derogatory name for an indigenous group of people that had resided there. The local publication, "Buffalo Rising", has listed articles such as " Chief Hill asks Mayor Brown to support renaming of Squaw Island" (2014). Grassroots organizations were successful in bringing about this awareness and having the name changed to Unity Island.

Limitations and Conclusion:

Limitations:

One of the limitations of this study is that Asthma rates were studied at the zipcode level, due to privacy concerns, the smallest geographical public health data on Asthma by the NYSDOH was available at the zipcode level. Furthermore, I had used secondary data instead of collecting my own. As stated above, the health data by the New York State Department of Health was given as rates per zipcode per 10,000 individuals, and this rate is of Hospital Asthma Emergency Discharge Rates. This allowed me to focus on Zip Code Tabulation Areas (ZCTA) on ArcMaps[9] and spatially join.

Another limitation of this study is the location/siting of Toxic Release Inventory (TRI) facilities seen as areas of exposure. While this may not be the best causal

[9] ESRI ArcMap. ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.

relationship between Asthma prevalence, and has been discussed in the literature review section above, further research may also incorporate air dispersion models, and air quality estimates, etc. Other weaknesses of using TRI data have been mentioned above, in my literature review section.

Although not a limitation per se, in addition to studying TRI facilities locations as documented by the EPA website database, other studies have also focused attention on non-reporting facilities, and found that the accumulation of nonreporting facilities have showed an effect on asthma prevalence. Future studies can incorporate non-reporting facilities in a hotspot analysis. I would like to see if that would further support the areas with 99% confidence and increase of z-values.

The final conclusions that can be made from this study is that formerly redlined areas continue to have impacts on the neighborhood characteristics, as U.S. Census data shows that Blacks and Hispanics and minorities are still living in these areas. The predominantly higher Hispanic and Asian zipcodes regions have percentages that are too small (compared to the African American and White populations), and therefore would not make good candidates for studying these relationships. The optimized hotspot analysis shows stark differences between zipcodes/ZCTAs that are predominantly White and those that are predominantly Black and prevalence of Asthma. It also shows that ZCTAs of predominantly Black have a significance of 99% confidence level of TRI facilities in the zipcodes, whereas predominantly White ZCTAs show a 95% confidence level. The conceptual diagram of my study followed this framework, the effects of redlining are still apparent today, as lower socioeconomic status groups live in closer proximity to TRI facilities. The purpose of studying the redlined maps of various urban

centers of New York state was to distinguish which cities had an African American and minority population. Which allowed me to focus my study area of Buffalo, New York. The next step was to find which areas were labeled under “hazardous” and least desirable, and to see with U.S. Census data, if these areas still have segregation. Documents provided by the HOLC did show which zipcodes had higher than 50% population of the various different races. The next step in this analysis was to also look at poverty and minority data amongst the city using U.S. Census data. This step was also crucial, as it supports existing research that class and socioeconomic standing play a role in health burdens. Asthma rates (Emergency hospital discharge rates- to be specific) allowed me to find if areas had higher rates in certain neighborhoods, compared to others. The next step in the process was to also look at TRI facility locations.

My observations of the redlined maps showed that certain zipcodes were labeled as “hazardous”. Section D1 had the highest percentages of African Americans, with 95% labeled as “Negroes”. Section D3 had the second highest with 25% being African American. Section D2 was listed as 100% Italian and D4 with a 75% population of Polish. The neighborhoods redlined include zipcodes: 14208, 14209, 14206, 14202, 14204. The optimized Hot Spot analysis allowed the spatial scale to be chosen without having to choose one myself. In addition, I did not have to choose a parameter of conceptualization of spatial relationship, such as fixed-distance band, inverse distance band, or the zone of indifference.

The hotspot analysis allowed me to see if some areas were more significant than others. When we compare a higher socioeconomic group such as the predominantly White population zipcodes to the lower group, we do see a difference. My findings show

that African American neighborhoods had higher rates of asthma rates per 10,000 individuals, and more TRI facilities compared to White neighborhoods.

Future research can also use spatial analysis to incorporate schools and property values. Furthermore, in regards to buffer zones, future studies can compare population of asthma rates in the buffer region as well as outside of this zone.

When it comes to TRI location decisions, information should be available for the neighborhoods that are located near such facilities. Furthermore, the facilities should give incentives for being located in underprivileged areas. Some ideas can include, free health screenings that are monetarily covered by that facility. Other incentives can include contributing money for that local community in helping the social needs of that community. The current EPA guidelines for reporting, state that the facility reporting needs to only report if they are a certain size (given). Studies have shown that the cumulative impacts of small facilities that are not reporting also play a role in air quality and contribute to air pollution. For this reason, I would want the EPA to change their guidelines and require that all facilities, no matter their size to report their emissions and waste information.

This research has sparked some more questions from myself on the relationships between poverty/ race, health and segregation. Future studies should focus on neighborhoods of African American and Hispanic populations that show little to no redlining occurrences, and relationships between the existences of TRI facilities and presence of asthma and other ailments in those neighborhoods. It would also be interesting to investigate communities that have segregation, but not due to the ill effects of redlining, but instead with gentrification, when it comes to housing discrimination. It is

from my understanding that the lack of social mobility of disadvantaged groups continue to have detrimental effects on their economic, political and social well-being, and in turn, effect the whole of society.

Appendix A.

Figure 15.

Table for reference of maps 11-12.

Number referenced on map	Zipcode (ZCTA)	Redlined area (HOLC Map)
11	14207	
20	14216	
18	14214	
19	14215	
17	14213	
26	14222	
13	14218	
12	14211	
6	14201	
7	14204	Yes
9	14204	Yes

Figure 13.2 Table. For reference maps 11-12

Number Referenced on map	Zipcode	
15	14211	
16	14212	
10	14206	Yes
14	14210	
24	14220	
8	14202	Yes

Figure. 13.3 Table of Zipcode and ZCTA Walkover Uniform Data Systems (UDS Mapper) [10]

ZIP Code	ZIP Code Type	City Name	State	ZCTA
14201	Zip Code Area	Buffalo	NY	14201
14202	Zip Code Area	Buffalo	NY	14202
14203	Zip Code Area	Buffalo	NY	14203
14204	Zip Code Area	Buffalo	NY	14204
14205	Post Office or large volume customer	Buffalo	NY	14203
14206	Zip Code Area	Buffalo	NY	14206
14207	Zip Code Area	Buffalo	NY	14207
14208	Zip Code Area	Buffalo	NY	14208
14209	Zip Code Area	Buffalo	NY	14209
14210	Zip Code Area	Buffalo	NY	14210
14211	Zip Code Area	Buffalo	NY	14211
14212	Zip Code Area	Buffalo	NY	14212
14213	Zip Code Area	Buffalo	NY	14213
14214	Zip Code Area	Buffalo	NY	14214
14215	Zip Code Area	Buffalo	NY	14215
14216	Zip Code Area	Buffalo	NY	14216
14217	Zip Code Area	Buffalo	NY	14217

[10] UDS Mapper Copyright © 2019 by the American Academy of Family Physicians. Accessed March 2019 < https://www.udsmapper.org/index.cfm >

14218	Zip Code Area	Buffalo	NY	14218
14219	Zip Code Area	Buffalo	NY	14219
14220	Zip Code Area	Buffalo	NY	14220
14221	Zip Code Area	Buffalo	NY	14221
14222	Zip Code Area	Buffalo	NY	14222
14223	Zip Code Area	Buffalo	NY	14223
14224	Zip Code Area	Buffalo	NY	14224
14225	Zip Code Area	Buffalo	NY	14225
14226	Zip Code Area	Buffalo	NY	14226
14227	Zip Code Area	Buffalo	NY	14227
14228	Zip Code Area	Buffalo	NY	14228
14231	Post Office or large volume customer	Buffalo	NY	14221
14233	Post Office or large volume customer	Buffalo	NY	14203
14240	Post Office or large volume customer	Buffalo	NY	14206
14241	Post Office or large volume customer	Buffalo	NY	14225
14260	Zip Code Area	Buffalo	NY	14228
14261	Post Office or large volume customer	Buffalo	NY	14261
14263	Post Office or large volume customer	Buffalo	NY	14203

14264	Post Office or large volume customer	Buffalo	NY	14203
14265	Post Office or large volume customer	Buffalo	NY	14221
14267	Post Office or large volume customer	Buffalo	NY	14202
14269	Post Office or large volume customer	Buffalo	NY	14043
14270	Post Office or large volume customer	Buffalo	NY	14203
14272	Post Office or large volume customer	Buffalo	NY	14043
14273	Post Office or large volume customer	Buffalo	NY	14203
14276	Post Office or large volume customer	Buffalo	NY	14206
14280	Post Office or large volume customer	Buffalo	NY	14203

Figure 13.1 Table Results of Optimized Hot Spot Analysis

OBJECTID	SOURCE_ID	Join_Count	Shape_Length	Shape_Area	GiZScore	GiPValue	NNeighbors	Gi_Bin
1	1	0	0.4479393	0.0067997	-1.187703	0.2349505	17	0
2	2	2	1.1084847	0.0200499	-2.3537541	0.0185849	15	-2
3	3	30	0.4166709	0.0042916	3.1394367	0.0016927	37	3
4	4	0	0.0499413	8.78E-05	-0.7497007	0.453435	18	0
5	5	0	0.3453012	0.0035227	0.1358636	0.8919291	30	0
6	6	0	0.1119106	0.0003099	3.0995324	0.0019383	40	3
7	7	1	0.1349097	0.0003491	2.9601747	0.0030746	41	3
8	8	8	0.2741424	0.0010884	2.7341955	0.0062533	43	2
9	9	9	0.1554188	0.0005127	3.0591471	0.0022197	41	3
10	10	11	0.2280999	0.0013845	2.7174744	0.0065782	45	2
11	11	13	0.2015634	0.0011204	3.1394367	0.0016927	37	3
12	12	1	0.1026909	0.0003881	3.0591471	0.0022197	41	3
13	13	1	0.1090119	0.0002611	3.0591471	0.0022197	41	3
14	14	16	0.2288061	0.0009503	2.7174744	0.0065782	45	2
15	15	7	0.2503113	0.001158	2.9215208	0.0034833	42	2
16	16	1	0.193774	0.0005437	2.8516513	0.0043493	44	2
17	17	8	0.1469201	0.0006775	3.1977885	0.0013849	40	3
18	18	3	0.2224859	0.0008178	3.1913033	0.0014163	39	3
19	19	7	0.2716296	0.0014079	3.0504044	0.0022853	40	3
20	20	1	0.1910695	0.0008035	3.1913033	0.0014163	39	3
21	21	2	0.1847686	0.0009183	3.1394367	0.0016927	37	3
22	22	6	0.3485346	0.0024341	2.5970395	0.0094031	44	2
23	23	7	0.2653097	0.0020979	2.7174744	0.0065782	45	2
24	24	3	0.1619702	0.0011005	2.5014683	0.012368	47	2

25	25	1	0.5110205	0.0065807	3.0591471	0.0022197	41	3
26	26	0	0.1548862	0.0003645	3.1977885	0.0013849	40	3
27	27	0	0.1630517	0.0009809	3.1394398	0.0016927	38	3
28	28	11	0.4007627	0.0057971	2.3404735	0.0192593	49	2
29	29	14	0.3928391	0.0033937	3.1876048	0.0014346	43	3
30	30	0	0.2295534	0.001978	3.1394398	0.0016927	38	3
31	31	7	0.3315576	0.0024731	2.7399036	0.0061457	46	2
32	32	3	0.5540481	0.0046038	2.8531361	0.004329	36	2
33	33	0	0.1645503	0.0003426	3.1913033	0.0014163	39	3
34	34	4	0.9086398	0.0189016	-0.4003584	0.6888926	14	0
35	35	3	0.8000196	0.0137756	0.2944306	0.7684289	17	0
36	36	3	0.6247389	0.0075112	-1.6022365	0.1091033	13	0
37	37	0	0.5578866	0.0063641	-2.0199368	0.0433899	25	-1
38	38	0	0.0749694	0.0002164	3.0553406	0.0022481	44	3
39	39	0	0.6329987	0.0057023	-2.0086036	0.0445792	12	-1
40	40	2	0.4972091	0.0054161	2.8531361	0.004329	36	2
41	41	0	0.6146172	0.0066393	1.5037638	0.1326422	29	0
42	42	0	0.4068867	0.0049211	-2.0195313	0.043432	27	-1
43	43	0	0.6370211	0.0072865	-2.3729812	0.0176452	16	-2
44	44	0	0.0563817	6.48E-05	-2.2206546	0.0263744	14	-2
45	45	4	0.3240068	0.0024819	2.975166	0.0029283	45	3
46	46	0	0.487321	0.0040126	-0.4337806	0.6644477	19	0
47	47	0	0.3928556	0.0046938	2.848015	0.0043993	38	2

Facility Name	Zip Code	**Redlined/Close**	**Number of TRI in this Zipcode**	**Asthma Rate in This Zipcode**	**Emergency Visits**
CON AGRA / MAPLE LEAF MILLING INC	142033195	close	7	68	170.6
MATERION ADVANCED MATERIALS TECHNOLOGIES & SERVICES INC	14214	close	4		
TRICO MFG COMPONENTS, PLANT 2	14214	close			
UPSTATE FARMS COOPERATIVE INC BISON DIV	14204	red	5	286	182.1
OSMOSE UTILITIES SERVICES	14209	red	1	113	69.8
BUFLOVAK LLC (FORMERLY BUFFALO TECHNOLOGIES CORP)	14211	close	5	836	219.1
KEYSTONE CORP	14213		5		
INGERSOLL RAND CO	14225		6		
ZEMCO INDUSTRIES DBA TYSON FOODS INC	14210	close	17	432	159.5
KEYSTONE CORP	14214				
DARLING & CO	14206	red	11	451	121.1
COLAD GROUP INC	14210	close			
MOD-PAC CORP	14207	close	12	556	128.7
PRAXAIR DISTRIBUTION INC	14212		1	333	174.8
FIBRERIGHT MANUFACTURING INC	14210	close			
SUIT-KOTE BUFFALO	14227		1	145	35.4
LAFARGE HOPKINS STREET READY MIX	14220		3	324	73.1
MARLETTE NATIONAL CORP	14207	close			
PAR FOAM PRODUCTS INC	14210	close			
PVS CHEMICAL SOLUTIONS	14210	close			
INTERNATIONAL EXTRUDED PRODUCTS LLC	142154095		7	1,298	183.4
AMERICAN AXLE & MANUFACTURING INC. BUFFALO FACILITY	14215				
M A MOSLOW & BROTHER INC	142153194				

HONEYWELL INTERNATIONAL INC. - BUFFALO RESEARCH LABORATORY	14210	close			
PEPSI-COLA BOTTLING CO BUFFALO	14225			342	57.1
GM POWERTRAIN TONAWANDA	14207	close			
FREEZER QUEEN FOODS INC	14203	close	7		
SMITH MCDONALD CORP	142255520				
DINAIRE CORP	14203	close			
BUFFALO BUMPER EXCHANGE	14206	red			
BOOTH OIL CO	14210	close			
BUFFALO COLOR CORP	14210	close			
TRICO PRODS CORP	14203	close			
BUFFALO CHINA INC	14210	close			
EXXONMOBIL OIL CORP BUFFALO TERMINAL	14210	close			
HENKEL CORPORATION	14203	close			
PRATT & LAMBERT UNITED INC	14207	close			
GLOBE INTERNATIONAL INC	14206	red			
BOC GASES	14210	close			
AMERICAN ENVELOPE CO BUFFALO ENVELOPE CO DIV	14203	close			
TMP TECHNOLOGIES INC	14215				
AURUBIS BUFFALO INC	14207	close			
JOHNSTOWN WIRE TECHNOLOGIES GREAT LAKES DIV	14219		2		
STETSON CHEMICALS INC	14204	red	4		
BUFFALO FORGE CO	14204	red			
CROSBY CO	14240		2		
TRINITY INDUSTRIES INC BUFFALO INC	142190136		2		
MACLEAN FOGG INC	14206	red			
DUPONT YERKES PLANT	14207	close			
CHEMICAL DISTRIBUTORS INC	14206	red			

ADM MILLING CO	14203	close			
LACLEDE MFG CO	142280009		1	103	20.5
S.A. DAY BUFFALO FLUX FACILITY JOHNSON MANUFACTURING CO	14213		5		
GRAPHIC CONTROLS LLC	14204	red			
ARO CORP LIFE SUPPORT PROD DIV	14227		2		
CARTON CRAFT CORPORATION	14204	red			
UC COATINGS LLC	14214				
BUFFALO METAL CASTING CO INC	14207	close			
FEDCO AUTOMOTIVE COMPONENTS CO	14207	close			
RICH PRODUCTS MANUFACTURING CORP	14213				
MEAD-HATCHER INC	142161045				
SAFETY-KLEEN SYSTEMS INC BUFFALO OIL RECOVERY FACILITY	14210	close			
MIKEN COMPANIES INC	14213				
MENTHOLATUM CO	142131305				
GIOIA PASTA CO INC	14207	close			
GENERAL MOTORS CORP HARRISON RADIATOR DIV	14215				
FERRO CORP	14218				
SMITH METAL ARTS	142072480	close			
CONAX BUFFALO CORP	14225		8		
L D MCCAULEY INC	14215		6		
ENGINEERED COMPOSITES INC	14206	red			
UNICELL BODY CO INC	14206	red			
INNOVATIVE CHEMICAL CORP	14211	close			
NESL - WEHRLE/BARTON FACILITY	14221				
BATTENFELD AMERICAN INC	14206	red			
MGS BUFFALO INC	14225				
NIAGARA TRANSFORMER CORP	14225				

CURTIS SCREW CO INC	142131793				
GRAPHIC CONTROLS CORP	14210	close			
H HYMAN DRUM & BARREL CORP	142101296	close			
PM REFINING INC	14202	red			
GOLDEN TITANIUM INC	14206	red			
MASTER BUILDERS INC	14210	close			
NIAGARA CERAMICS CORP	14210	close			
POHLMAN FOUNDRY CO INC	14206	red			
CONTRACT PHARMACEUTICALS LTD NIAGARA	142131032	close			
NIAGARA FIBERGLASS INC	14220				
SORRENTO LACTALIS INC	14220				
RODGARD	14206	red			
TRICO PRODS CORP, PLANT #3	14210	close			
FRONTIER HOT DIP GALVANIZING INC	14207	close			
GIBRALTAR STRIP STEEL WALDEN	14225				
BIG HEART PET BRANDS	14211				
SCOTT CASTINGS CORP	14207	close			
FIBRON PRODUCTS INC	142080430	red	1	261	134.8
ETHOX CORP	14204	Redlined/ Close			
FUEL SYS LLC	142192306				
M/A-COM CERAM INC	14207	close			
LEICA REICHERT JUNG CAMBRIDGE INSTRUMENTS	14215				
FORD MOTOR CO BUFFALO STAMPING PLANT	14219				
ATLAS PLASTICS INC	14210	close			
JAMESTOWN CONTAINER COMPANIES/ BUFFALO SPECIALTIES DIV	14225				
HARMAC MEDICAL PRODUCTS INC	142111747				
ELF ATOCHEM NA INC ORGANIC PEROXIDES DIV PLANT	14240				

RAPID SERVICE ENGRAVING CO INC	14211				
SMITH MCDONALD CORP	142254797				
GENERAL MILLS OPERATIONS INC	14203	close			
REICHHOLD CHEMICALS INC COATING POLYMERS & RESINS DIV	14225				
FENNER PRECISION	14215				
ISLAND OASIS MANUFACTURING	14213				
		20 red/ 44close			
GRAPHIC CONTROLS CORP					

Figure 14.2 Table of Asthma Emergency Department Discharge rates in Erie County
NYSDOH data 2012-2014

Erie County		
	ED Visits2012-2014	**ED Visit Rate**
ZIP Code		
14001	17	9.8
14004	28	11.6
14006	39	20.8
14025*	8	13.1
14026	s	s
14030*	7	22.5
14031	16	9.6
14032*	7	4.5
14033	s	s
14034	s	s
14043	118	24.7
14047	40	31.8
14051	34	9
14052	32	10.3
14055	s	s
14057	19	12.5
14059	18	10.7
14068	14	10.2
14069	s	s
14070	17	10
14072	48	12.2
14075	191	24.8
14080	14	17.5

14081	33	51.1
14085	21	14.4
14086	67	11
14091*	6	30.1
14102	s	s
14111*	8	13.2
14127	77	14
14134	s	s
14139*	6	14.1
14141	36	25.6
14150	289	38.4
14170*	8	18.2
14201	373	167.7
14202	84	102.4
14203	68	170.6
14204	286	182.1
14206	451	121.1
14207	556	128.7
14208	261	134.8
14209	113	69.8
14210	432	159.5
14211	836	219.1
14212	333	174.8
14213	579	117.1
14214	350	83.6
14215	1,298	183.4
14216	266	61
14217	147	34.5
14218	299	87.1
14219	58	28.2
14220	324	73.1

14221	95	10.4
14222	92	35.7
14223	139	33.8
14224	178	24.7
14225	342	57.1
14226	97	17.8
14227	145	35.4
14228	103	20.5
14260	s	s
ASTHMA ED VISIT RATE ERIE COUNTY - 55.0 NEW YORK STATE - 76.3		

Figure 14.3 Table of Toxic Release Inventory Facilities and whether they are located in former redlined areas.

TRI locations in Buffalo, New York	**Are the TRI Facility located in The formerly Redlined Area?**
BAITZ AVE	
BROADWAY	
BROADWAY	
BROADWAY	
ELK ST	
ELMWOOd	
EXCHANGE ST	Yes
FOREST AVE	
FUHRMANN BLVD	
GANSON ST	
GENESEE ST	

HOPKINS STREET	
JOHN GLENN DR	
KATHERINE ST	Yes
LAKE SHORE RD	
MAIN ST	
MAIN ST	
MICHIGAN AVE	
MICHIGAN AVE	
MILITARY RD	
NIAGARA ST	yes
NIAGARA ST	yes
NORFOLK AVE	
OHIO ST	
OHIO ST	
OKELL ST	
PEARL ST	
PRATT ST	Yes
RIVER RD	
S PARK AVE	
SENECA ST	yes
SONWIL DR	
TONAWANDA ST	
VAN RENSSELAER ST	
WALDEN AVE	
WEHRLE DR	
WILLIAMS ST	yes
ASH ST	yes
BAILEY AVE	
BOLTON PL	
BROADWAY	
BUSHNELL AVE	

CHILDS ST	
CLARENCE AVE	
CLINTON	yes
CLINTON ST	yes
CLYDE AVE	
DALE RD	
DOROTHY ST	
E DELAVAN AVE	
E FERRY ST	
EGGERT & SUGAR RDS	
ELLICOTT ST	
ELMWOOD AVE	
ELMWOOD AVE	
ELMWOOD AVE	
ELMWOOD AVE	
EXCHANGE ST	yes
FLORIDA ST	
FOOT OF KATHERINE ST	yes
GENESEE S	
GRIDER ST	
HAMBURG TURNPIKE GATE 6	yes
HAYES PL	
HERTEL AVE STE	
KATHERINE ST	yes
KENSINGTON AVE	
LAKESHORE RD	
LEE ST	
LEE ST	
METCALFE ST	
MILITARY RD	
MILTON	

MSGR. VALENTE DRIVE	
NIAGARA ST	yes
NIAGARA ST	yes
NIAGARA ST	yes
NIAGARA ST	yes
NIAGARA STREET	yes
NORTHLAND AVE	
PEABODY ST	
RANO ST	
RIVER RD	
ROBERTS AVE	
SAYRE ST	
SENECA ST	yes
SENECA ST	yes
SOUTH DIVISION ST	
THIELMAN DR	
TONAWANDA ST	
TONAWANDA ST	
URBAN ST	
VAN RENSSELAER ST	yes
WALDEN AVE	
WALDEN AVE	
WALDEN AVE	
WALDEN AVE	
WALDEN AVE	
WILLET RD	
Total: 99 TRI facilities	22 locations in redlined streets

Figure 14.4 This table are non-reporting facilities [11]

Facility name (non-TRI)	**Address**	**Type of Industry**
A to Z Home Restoration	22 Oakland Place	Construction
	Buffalo, NY 14222	
Absolute Concrete LLC	6305 Transit Road	Construction
	East Amherst, NY 14051	
All-Bright Painting	129 Norwood Dr	Construction
	West Seneca, NY 14224	
Artisan Concrete Overlays of Western New York	5131 Pittsburg Rd.	Construction
	Hamburg, NY 14075	
Artisan Kitchens & Baths	200 Amherst St	Construction
	Buffalo, NY 14207	
Beautiful Homes by Thomas	145 Crescent Ave	Construction
	Buffalo, NY 14214	

[11] Buffalo, NY local directory < https://www.buffalofirst.org/directory > Accessed March 2019

Beyond the Basics Property Services, Inc.	 89 Lind Ave	Construction
	West Seneca, NY 14224	
Broadway Collision	 4685 Broadway	Automotive
	Depew, NY 14043	
Buffalo Networks	 146 Wellington	Construction
	Buffalo, NY 14216	
Carubba Collision	 2643 Delaware Ave.	Automotive
	Buffalo, NY 14216	
Central Terminal Restoration Corporation	 495 Paderewski Drive	Construction
	PO BOX 468	
	Buffalo, NY 14212	
DMR Masonry Restoration	 1133 Pierce Ave	Construction
	Niagara Falls, NY 14301	
DWC Mechanical Inc.	 100 John Glenn Drive	Special Trade Contractors
	100 John Glenn Drive	
	Amherst, NY 14228	

Eberl Iron Works, Inc.	 128 Sycamore St.	Construction
	Buffalo, NY 14204	
eco logic STUDIO architecture & engineering, PLLC	 2495 Main St.	Construction
	Ste. 431	
	Buffalo, NY 14214	
Heatwave Heating and Cooling	 100 John Glenn Drive	Special Trade Contractors
	100 John Glenn Drive	
	Amherst , NY 14228	
Ingersoll Painting and Construction Inc.	 1890 Niagara St.	Construction
	Buffalo, NY 14207	
Jansen | Kiener Consulting Engineers PC	 429 Franklin St #200	Construction
	Buffalo, NY 14202	
JD SUPPLY	 200 COLVIN WOODS PARKWAY	Construction
	TONAWANDA, NY 14150	

Joy Kuebler Landscape Architect, PC	 65 Zimmerman St	Construction
	North Tonawanda, NY 14120	
Kushnick Pallaci, PLLC	 300 International Drive, Suite 100	Construction
	Buffalo, NY 14221	
Matt Kandefer Plumbing Inc	 2215 Broadway St	Construction
	#A	
	Buffalo, NY 14212	
MP Construction	 61 S. Vernon Street	Construction
	Middleport, NY 14105	
MPD Architecture	 2619 N. Main Street	Construction
	Newfane, NY 14108	
Northeast Collision	 3480 Transit Rd	Automotive
	Depew, NY 14043	
Nussbaumer & Clarke, Inc.	 3556 Lake Shore Road	Construction
	Suite 500	
	Buffalo, NY 14219	

PB's Greenthumb Landscaping LLC	4562 East Overlook Drive	Construction
	Buffalo, NY 14221	
PJK Roofing Inc	1227 East Main St	Construction
	East Aurora, NY 14052	
Renewable Rochester	780 Ridge Road	Construction
	Webster, NY 14580	
Schuster Construction, LLC	360 Gould Avenue	Construction
	Depew, NY 14086	
Solar & Wind FX	5115 South Hill Road	Construction
	Canandaigua, NY 14424	
Solar Liberty	6500 Sheridan Drive	Construction
	Suite 120	
	Buffalo, NY 14221	
The ReSource	298 Northampton St.	Construction
	Buffalo, NY 14208	
Tortora Property Management	353 Elmwood Ave	Construction
	Suite 1	
	Buffalo, NY 14222	

Woodstream Nurseries	8500 Wolcott Rd	Construction
	Clarence Center, NY 14103	
Young Waterproofing Co	413 Shanley St	Construction
	Buffalo, NY 14206	
Zenner and Ritter	3404 Bailey Avenue	Construction
	Buffalo, NY 14215	

References:

Abel, Troy (2008) Skewed Riskscapes and Environmental Injustice: A Case Study of Metropolitan St. Louis. Environmental Management. 42.2 (Aug. 2008): p232+. DOI: http://dx.doi.org.proxy.binghamton.edu/10.1007/s00267-008-9126-2

Agarwal, N., Banternghansa, C., Bui, L.T., 2010. Toxic exposure in America: estimating fetal and infant health outcomes from 14 years of TRI reporting. J. Health

Alexander Diane, and Currie Janet. Is it who you are or where you live? Residential segregation and racial gaps in childhood asthma. J Health Econ. Author manuscript; available in PMC 2018 Aug 28. Published in final edited form as: J Health Econ. 2017 Sep; 55: 186–200. Published online 2017 Jul 25. DOI: 10.1016/j.jhealeco.2017.07.003

Amadeo, Brice. Robert, Celine. Rondeau, Virginie. Mounouchy, Marie-Alice. Impact of close-proximity air pollution on lung function in schoolchildren in the French West Indies. 2015 BioMed Central Public Health.

Allaerts, W., & Chang, T. W. (2017). Skewed Exposure to Environmental Antigens Complements Hygiene Hypothesis in Explaining the Rise of Allergy. Acta Biotheoretica, 65(2), 117–134. https://doi-org.proxy.binghamton.edu/10.1007/s10441-017-9306-

Alexandre-Silva, G. M., Brito-Souza, P. A., Oliveira, A. C. S., Cerni, F. A., Zottich, U., & Pucca, M. B. (2018). The hygiene hypothesis at a glance: Early exposures, immune mechanism and novel therapies. Acta Tropica, 188, 16–26. https://doi-org.proxy.binghamton.edu/10.1016/j.actatropica.2018.08.032

Avery, R. B., & Rendall, M. S. (2002). Lifetime Inheritances of Three Generations of Whites and Blacks. *American Journal of Sociology, 107*(5), 1300. https://doi-org.proxy.binghamton.edu/10.1086/344840

Batty M, Mackie S: The calibration of gravity, entropy, and related models of spatial interaction. Env and Planning 1972, 4: 205-233.

Baxi, S. N., Muilenberg, M. L., Rogers, C. A., Sheehan, W. J., Gaffin, J., Permaul, P., & ... Phipatanakul, W. (2013). Exposures to molds in school classrooms of children with asthma. Pediatric Allergy & Immunology, 24(7), 697-703. doi:10.1111/pai.12127

Baxter M: Estimation and inference in spatial interaction models. Prog Human Geog 1983, 7: 40-59.

Bedolla-Barajas, Morales-Romero , Ramses-Bedolla-Pulido , Fabiola-García-Padilla, Hernández-Colín. Associated Markers for Adult-onset Allergic Asthma. Iran J Allergy Asthma Immunol. 2015 Oct;14(5):545-51.

Belanger, K. K., Ameredes, B. T., Boldogh, I., & Aguilera-Aguirre, L. (2016). The Potential Role of 8-Oxoguanine DNA Glycosylase-Driven DNA Base Excision Repair in Exercise-Induced Asthma. Mediators Of Inflammation, 1-15. doi:10.1155/2016/3762561

Been, V., & Gupta, F. (1997). Coming to the nuisance or going to the barrios—A longitudinal analysis of environmental justice claims. Ecology LQ, 24, 1.

Beyer, K. M. M., Zhou, Y., Matthews, K., Bemanian, A., Laud, P. W., & Nattinger, A. B. (2016). New spatially continuous indices of redlining and racial bias in mortgage lending: links to survival after breast cancer diagnosis and implications for health disparities research. Health & Place, 40, 34–43. https://doi-org.proxy.binghamton.edu/10.1016/j.healthplace.2016.04.014

Bickford,A., and D. Massey. (1991). “Segregation in The Second Ghetto: Racial and Ethnic Segregation in American Public Housing. Social Forces 69 1011-1036

Boudreaux, E.D., Emond, S.D., Clark, S., & Camargo, C.A., Jr. (2003). Acute asthma among adults presenting to the emergency department: The role of race/ethnicity and socioeconomic status, Chest, 124(3), 803-812

Boulet, L. (2008). Influence of obesity on the prevalence and clinical features of asthma. Clinical & Investigative Medicine, 31(6), E386-E390

Bowen WM, Salling MJ, Haynes KE, Cyran EJ: Toward Environmental Justice: Spatial Equity in Ohio and Cleveland. Annals of the Assn of Am Geog 1995, 85: 641-663

Beaulieu, Mark. Tracey, Continelli. Benefits of Segregation for White Communities: A Review of the Literature and Directions for Future Research. (2011) Journal of African American Studies

Bloomfield, S. F., Rook, G. A., Scott, E. A., Shanahan, F., Stanwell-Smith, R., & Turner, P. (2016). Time to abandon the hygiene hypothesis: new perspectives on allergic

disease, the human microbiome, infectious disease prevention and the role of targeted hygiene. Perspectives In Public Health, 136(4), 213–224. https://doi-org.proxy.binghamton.edu/10.1177/1757913916650225

Brightling C.E., S. Gupta, S. Gonem, S. Siddiqui. 2012. Lung damage and airway remodeling in severe asthma. Clin. Exp. Allergy. 42:638–649. doi:10.1111/j.1365-2222.2011.03917.x

Britannica. Ronald Coase Encyclopedia Britannica. Encyclopedia Britannica, Inc. Dec. 2018 <https://www.britannica.com/biography/Ronald-Coase>Accessed April 22, 2019

Burger, Joana. Gochfield Michael. (2011) Conceptual Environmental Justice Model for Evaluating Chemical Pathways of Exposure in Low-Income, Minority, Native American, and Other Unique Exposure Populations. American Journal of Public Health.

Bullard, R.D., and B.H. Wright. (2012). The Wrong Complexion for Protection: How The Government Responds to Disaster Endangers African American Communities. NYU Press.

Centers for Disease Control. *Learn How to Control Asthma.* U.S. Dept of Health and Human Services. Retrieved on: February 3, 2019

Coffey, B. and J. C. Gocker. (1998). "Racial Disparities in Mortgage Lending: The Example of Urban Ohio." Social Justice, 25(3), 115-127.

Carlsen, K. L., Roll, S., Carlsen, K., Mowinckel, P., Wijga, A. H., Brunekreef, B., & ... Asarnoj, A. (2012). Does Pet Ownership in Infancy Lead to Asthma or Allergy at School Age? Pooled Analysis of Individual Participant Data from 11 European Birth Cohorts. Plos ONE, 7(8), 1-12. doi:10.1371/journal.pone.0043214

Centers For Disease Control (CDC) <https://www.cdc.gov/asthma/> accessed May 2017.

Chakraborty, P., Ghosal, K., Sarkar, E., & Gupta Bhattacharya, S. (2016). Atmospheric pollen grains of a suburban area near India-Bangladesh border with reference to their allergenic potential and probable effect on asthma-related hospital admission. Current Science (00113891), 111(9), 1486-1491. doi:10.18520/cs/v111/i9/1486-1491

Chen, T., J. Gokhale, S. Shofer, and W. G. Kuschner. 2007. Outdoor air pollution: Nitrogen dioxide, sulfur dioxide, and carbon monoxide health effects. The American Journal of the Medical Sciences 333:249–256

Conley, Jamison. Estimation of exposure to toxic releases using spatial interaction

modeling. 2011. International Journal of Health Geographics.

Corrigan et al. V. Buckley. 1926. 271. U.S. 323; 46 S. Ct. 521; 70 L. Ed. 969 (May 24).

Crinnion, Walter. Do Environmental Toxicants Contribute to Allergy and Asthma? 2012. Environmental Medicine Alternative Medicine Review.

Croen LA, Shaw GM, Sanbonmatsu L, Selvin S, Buffler PA: Maternal Residential Proximity to Hazardous Waste Sites and Risk for Selected Congenital Malformations. Epidemiology 1997, 8:347-354

Campbell (2010) and Hamilton (1995) say that, the causes of firms' siting decisions fall into three categories: "pure discrimination; the Coase theorem (Coase, 1960); and the theory of collective action.

Campbell, H. E., Peck, L. R., & Tschudi, M. K. (2010). Justice for All? A Cross-Time Analysis of Toxics Release Inventory Facility Location. Review of Policy Research, 27(1), 1–25. https://doi-org.proxy.binghamton.edu/10.1111/j.1541-1338.2009.00424.x

Collins Chiquita. Williams David. 1999. Segregation and Mortality: The Deadly Effects of Racism? Sociological Forum. September 1999, Volume 14, Issue 3, pp 495–523

Conley Jamison, (2011) Estimation of Exposure to Toxic Releases Using Spatial Interaction Modeling. Journal of Health Geographics

Coyle J.T., PUTTFARCKEN P, Oxidative stress, glutamate, and neurodegenerative disorders. 1993. Science

Cutter, S. L. (2006). Hazards Vulnerability and Environmental Justice Societal responses to environmental hazards. Published by Taylor and Francis

Dent A.L, Fowler D.A., Kaplan B.M., Zarus G.M., and Henriques W.D. (2000) USING GIS TO STUDY THE HEALTH IMPACT OF AIR EMISSIONS.DRUG AND CHEMICAL TOXICOLOGY, 23(1), 161±178 (2000)

Desmond, M. 2016. Evicted: Poverty and profit in the American City. New York: Crown.

Diener E, Suh EM, Lucas RE and Smith HL (1999) Subjective well-being: Three decades of progress. Psychological Bulletin 125: 276–302.

Downey, L. (1998). Environmental injustice: Is race or income a better predictor? Social Science Quarterly, 79(4), 766–778.

Dolinoy Dana, Miranda Marie. (2004) GIS Modeling of Air Toxics Releases from TRI-Reporting and Non-TRI-Reporting Facilities: Impacts for Environmental Justice. Environmental Health Perspective.

Do, D. C., Zhao, Y., & Gao, P. (2016). Cockroach allergen exposure and risk of asthma. Allergy, 71(4), 463-474. doi:10.1111/all.12827

Downey Liam., Environmental Stressors: The Mental Health Impacts of Living Near Industrial Activity 2005. Journal of Health and Social Behavior .

Duncan, O. D. & Duncan, B. (1957). The Negro Population of Chicago: A Study of Residential Succession. Chicago, IL: The University of Chicago Press.

Ebisu, K., Holford, T. R., Belanger, K. D., Leaderer, B. P., & Bell, M. L. (2011). Urban land-use and respiratory symptoms in infants. Environmental Research, 111(5), 677-684. doi:10.1016/j.envres.2011.04.004

Eckerd, A. Campbell, H. Kim, Y. Social Capital and Environmental Justice: An Agent-Based Model. Prepared for APPAM 2013, Washington, DC Panel: Methods For Addressing Social System Complexity In Policy Evaluation With An Application To Public Health Th, Nov. 7, 2013, 3-4:30. "Used with permission".

Edwards,G. , Reid, L., Hunter, C,. (2016) Environmental justice, capabilities, and the Theorization of Well-being. Progress in Human Geography 2016, Vol. 40(6) 754–769

Eldeirawi, K., Kunzweiler, C., Combs, A. T., & Persky, V. W. (2016). In utero exposure to pets is associated with asthma and wheezing in Mexican American children. Journal Of Asthma, 53(4), 374-381. doi:10.3109/02770903.2015.1104693

Encyclopædia Britannica, "Ronald Coase", 2018, Encyclopædia Britannica, inc. Date published December 25, 2018. Retrieved from : https://www.britannica.com/biography/Ronald-Coase

Erle D., Sheppard D. (2014) The cell biology of asthma. Journal of Cell Biology

ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute. ArcGIS® software by Esri. ArcGIS® and ArcMap™

Faber, D., and E. J. Krieg. 2002. Unequal Exposure to Ecological Hazards: Environmental injustices in the Commonwealth of Massachusetts. Environ. Health Perspect. 277–288.

Fazzo, L., F. Minichilli , M. Santoro , A. Ceccarini , M. Della Seta , F. Bianchi , P. Comba and M. Martuzzi. Hazardous Waste and Health Impact: A Systematic Review of The Scientific Literature. 2017. Environmental Health

Fleuret S and Atkinson S (2007) Wellbeing, health and geography: A critical review and research agenda. New Zealand Geographer 63: 106–118.

Franziska, Rosser. Forno Erik. Brehm, John. Proximity to a Major Road and Plasma Cytokines in School-Aged Children. 2016. Pediatric Allergy, Immunology & Pulmonology.

Fortunato Lea. Spatio-temporal patterns of bladder cancer incidence in Utah (1973-2004) and their association with the presence of toxic release inventory sites. 2011. International Journal of Health Geographics.

Foreman, Christopher. (1998) The Promise and Peril of Environmental Justice. Washington D.C. Brookings Institution Press

Goering, J. M. (1978). Neighborhood Tipping and racial transition: A review of social science evidence. Journal of the American Planning Institute, 44(1), 68-78.

Goodman JE, Loftus CT, Liu X, Zu K (2017) Impact of respiratory infections, outdoor pollen, and socioeconomic status on associations between air pollutants and pediatric asthma hospital admissions. PLoS ONE 12(7): e0180522. https://doi.org/10.1371/journal.pone.0180522

Goodman, Kyle. Environmental Justice and GIS: A Comparison of Three GIS Methods for Estimating Vulnerable Population Exposed to Brownfield Pollution in Portland, Oregon. 2017. Portland State University.

Gonzalez-Barcala, F. J., Aboal-Viñas, J., Aira, M. J., Regueira-Méndez, C., Valdes-Cuadrado, L., Carreira, J., & ... Takkouche, B. (2013). Influence of Pollen Level on Hospitalizations for Asthma. Archives Of Environmental & Occupational Health, 68(2), 66-71. doi:10.1080/19338244.2011.638950

Gotham, Kevin. “Beyond Invasion and Succession: School Segregation, Real Estate Blockbusting and The Political Economy of Neighborhood Racial Transition (2002) City and Community

Helfand Gloria, Peyton James. (1999) A conceptual Model of Environmental Justice. Social Science Quarterly 80(1)

Hendryx, Michael., Luo, Juhua., 2013. Cancer hospitalizations in rural-urban areas in relation to carcinogenic discharges from Toxics Release Inventory facilities. Int. J. Environ.Health Res. 23 (2), 155–169

Hendryx Michael., Luo Juhua., Total and cardiovascular mortality rates in relation to discharges from toxics release inventory sites in the United States. 2014. Environmental Research.

Herbst, C. M., & Lucio, J. (2016). Happy in the Hood? The Impact of Residential Segregation on Self-Reported Happiness. Journal of Regional Science, 56(3), 494–521. https://doi-org.proxy.binghamton.edu/10.1111/jors.12263

Ho, C.S., Hite, D., 2009. Toxic chemical releases, health effects, and productivity losses in the United States. J. Community Health 34, 539–546

Hollenbach Jessica, Elizabeth D. Schifano, Christopher Hammel, and Michelle M. Cloutier Exposure to secondhand smoke and asthma severity among children in Connecticut. (2017) PLoS One. 2017; 12(3): e0174541. Published online 2017 Mar 31. doi: 10.1371/journal.pone.0174541

Houssaini Ahmed S. Squalli, Messaouri, Hafida, Nasri, Isaad, Roth, Marie P. Air pollution as a determinant of asthma among schoolchildren in Mohammedia, Morocco. (2007) International Journal of Environmental Health. Volume 17 2007- Issue 4; 243-257

Huang Ching-Chun, Tung-Liang Chiang Pau-Chung Chen Shio-Jean Lin Hui-Ju Wen Yue Leon Guo. (2017) Risk factors for asthma occurrence in children with early-onset atopic dermatitis: An 8-year follow-up study.Pediatric Allergy and Immunology. First published: 23 November 2017 https://doi.org/10.1111/pai.12835

Huta V and Ryan RM (2009) Pursuing pleasure or virtue: The differential and overlapping well-being benefits of Hedonic and Eudaimonic motives. Journal of Happiness Studies 11: 735–762.

Irvin, R. A., & Stansbury, J. S. (2004). Citizen Participation in Decision Making: Is it Worth the Effort? *Public Administration Review*, *64*(1), 55-65. https://doi.org/10.1111/j.1540-6210.2004.00346.x

Jerrett M, Shankardass K, Berhane K, Gauderman WJ, Künzli N, Avol E, et al. Traffic-related air pollution and asthma onset in children: a prospective cohort study with individual exposure measurement. Environ Health Perspect 2008;116:1433-8.

Johnston Jill, Emily Werder, and Daniel Sebastian. Wastewater Disposal Wells, Fracking, and Environmental Injustice in Southern Texas. 2016 American Journal of Public Health

Jones-Correa, Michael. (2000) The Origins and Diffusion of Racial Restrictive Covenants. Political Science Quarterly.

Kalkstein, Adam. and Goodrich, Gregory. The Effect of ENSO and PDO on Three Airborne Pollutants in Phoenix, Arizona. 2012. Journal of the Arizona-Nevada Academy of Science.

Kampa, M., and E. Castanas. 2008. Human health effects of air pollution. Environmental Pollution 151:362–367

Kazuhiko, I., Weinberger, K. R., Robinson, G. S., Sheffield, P. E., Lall, R., Mathes, R., & ... Matte, T. D. (2015). The associations between daily spring pollen counts, over-the-counter allergy medication sales, and asthma syndrome emergency department visits in New York City, 2002-2012. Environmental Health: A Global Access Science Source, 14(1), 1-12. doi:10.1186/s12940-015-0057-0

Kesebir P and Diener E (2008) In pursuit of happiness: Empirical answers to philosophical questions. Perspectives on Psychological Science 3: 117–125.

Koebnick, Corinna. Fischer, Heidi. Daley, Matthew. (2016) Interacting effects of obesity, race, ethnicity and sex on the incidence and control of adult-onset asthma. 2016. Allergy, Asthma & Clinical Immunology.

Konisky, David M., and Christopher Reenock. 2013. "Compliance Bias and Environmental (In)Justice." Journal of Politics 75 (2): 506–19.

Kolmar, Chris. The 10 Best Buffalo, NY Neighborhoods To Live In For 2019. Dec. 2018. Home Snacks. Chasing Chains LLC. © https://www.homesnacks.net/best-neighborhoods-in-buffalo-ny-128140/

Kramer MR and Hogue CR. 2009 Is Segregation Bad for Your Health? Epidemiol Rev. 2009;31:178-94. doi: 10.1093/epirev/mxp001. Epub 2009 May 23.

Krieg, E.J. 2005 Race and Environmental Justice in Buffalo, NY: A ZIP Code and Historical Analysis of Ecological Hazards, Society and Natural Resources, 18:3, 199-213,
DOI:10.1080/08941920590908015
< https://doi.org/10.1080/08941920590908015>

Knibbs Luke, , Adriana M. Cort de Waterman, Brett G. Toelle, Yuming Guo, Lyn Denison, Bin Jalaludin, … Gail M. Williams. (2018). The Australian Child Health and Air Pollution Study (ACHAPS): A national population-based cross-sectional study of long-term exposure to outdoor air pollution, asthma, and lung function. Environment International. Elsevier Ltd, 120, 394–403. https://doi-org.proxy.binghamton.edu/https://dx.doi.org/10.1016/j.envint.2018.08.025

Kurowski, M., Jurczyk, J., Krysztofiak, H., & Kowalski, M. L. (2016). Exercise-induced respiratory symptoms and allergy in elite athletes: Allergy and Asthma in Polish Olympic Athletes (A2POLO) project within GA2LEN initiative. Clinical Respiratory Journal, 10(2), 231-238. doi:10.1111/crj.12210

LaChuisa, Chuck. Buffalo Architecture and History (website) The History of Buffalo: A Chronology Buffalo, New York. Accessed June 2019. https://buffaloah.com/h/1945.html#1930

Leong, R. W., Mitrev, N., & Ko, Y. (2016). Hygiene Hypothesis: Is the Evidence the Same All Over the World? Digestive Diseases (Basel, Switzerland), 34(1–2), 35–42. https://doi-org.proxy.binghamton.edu/10.1159/000442922

Liapunova EV, Popova IV, Petrov BA, Beliakov VA (2011). Impact of ambient air pollution on the prevalence of main symptoms of asthma in children. Gig Sanit (2011) 1;2:38-41.

Liu, A. H. (2015). Revisiting the hygiene hypothesis for allergy and asthma. The Journal Of Allergy And Clinical Immunology, 136(4), 860–865. https://doi-org.proxy.binghamton.edu/10.1016/j.jaci.2015.08.012

Logan, John. Martinez, Matthew. (2018) The Spatial Scale and Spatial Configuration of Residential Settlement: Measuring Segregation in the Postbellum South. American Journal of Sociology

Maantay, Juliana. (2007) Asthma and air pollution in the Bronx: Methodological and data considerations in using GIS for environmental justice and health research. 2007. Health & Place 13 (32–56).

Maantay, J. A., Tu, J., & Maroko, A. R. (2009). Loose-coupling an air dispersion model and a geographic information system (GIS) for studying air pollution and asthma in the Bronx, New York City. International Journal Of Environmental Health Research, 19(1), 59-79. doi:10.1080/09603120802392868

Marchetti, P., Pesce, G., Villani, S., Antonicelli, L., Ariano, R., Attena, F., & ... Marcon, A. (2017). Pollen concentrations and prevalence of asthma and allergic rhinitis in Italy: Evidence from the GEIRD study. Science Of The Total Environment, 5841093-1099. doi:10.1016/j.scitotenv.2017.01.168

Massey D.A. Denton N.A. The dimensions of residential segregation. Soc Forces. (1988);67(2):281–315.

Matricardi, P. M., Grüber, C., Wahn, U., & Lau, S. (2007). The asthma–obesity link in childhood: open questions, complex evidence, a few answers only. Clinical & Experimental Allergy, 37(4), 476-484.

Mattison, C. P., Khurana, T., Tarver, M. R., Florane, C. B., Grimm, C. C., Pakala, S. B., & ... Slater, J. E. (2017). Cross-reaction between Formosan termite (Coptotermes formosanus) proteins and cockroach allergens. Plos ONE, 12(8), 1-20. doi:10.1371/journal.pone.0182260

Medhi Alizadeh, Leila Ghasemi Hashtroodi, Zahra Chavoshzadeh and Nima Rezaei. (2016) Effect of Air Pollution in Frequency of Hospitalizations in Asthmatic Children, 2016 Acta Medica Iranica.

Mendell, M. J., Mirer, A. G., Cheung, K., Tong, M., & Douwes, J. (2011). Respiratory and Allergic Health Effects of Dampness, Mold, and Dampness.Related Agents: A Review of the Epidemiologic Evidence. Environmental Health Perspectives, 119(6), 748-756. doi:10.1289/ehp.l002410

Mittler Ron, (2002) Oxidative stress, antioxidants and stress tolerance. Trends in Plant Science. Cell Press

Mohai, Paul., & Bryant, B. (1991). Race, Poverty & the Distribution of Environmental Hazards: Reviewing the Evidence. Race, Poverty & the Environment, 2(3/4), 3-27. Retrieved from http://www.jstor.org/stable/41555195

Mohai, Paul ,Paula M. Lantz, Jeffrey Morenoff,, James S. House, and Richard P. Mero. (2009) Racial and Socioeconomic Disparities in Residential Proximity to Polluting Industrial Facilities: Evidence From the Americans' Changing Lives Study. 2009. American Journal of Public Health.

Molphy, J., Dickinson, J. W., Chester, N. J., Loosemore, M., & Whyte, G. (2017). The Effect of 400 Inhaled Salbutamol on 3 km Time Trial Performance in a Low Humidity Environment. Journal Of Sports Science & Medicine, 16(4), 581-588

Nejjari, Chakib and Benchekroun, Mohammed N. (2007) Air pollution as a determinant of asthma among schoolchildren in Mohamme´dia, Morocco. 2007. International Journal of Environmental Health Research.

Nelson, Robert. Winling, LaDale. Marciano, Richard. Conolly, Nathan. "Mapping Inequality," American Panorama, ed. Robert K. Nelson and Edward L. Ayers, accessed April 7, 2019, <https://dsl.richmond.edu/panorama/redlining/#loc=4/36.71/-96.93&opacity=0.8&text=bibliograph.>

National Community Reinvestment Coalition (NCRC). NOVEMBER 14, 2018.JASON RICHARDSON AND BRUCE MITCHELL. New Federal Reserve report supports NCRC redlining study. Accessed March 09, 2019. https://ncrc.org/new-federal-reserve-report-supports-ncrc-redlining-study/

Ocen, P. A. (2012). The New Racially Restrictive Covenant: Race, Welfare, and the Policing of Black Women in Subsidized Housing. UCLA Law Review, 59(6), 1540–1582.

Ogawa, H., Fujimura, M., Takeuchi, Y., & Makimura, K. (2013). Impact of Schizophyllum sensitization on decline of lung function in asthma. Journal Of Asthma, 50(7), 764-768. doi:10.3109/02770903.2013.803573

Orellano Pablo , Nancy Quaranta, Julieta Reynoso, Brenda Balbi, Julia Vasquez. Effect of outdoor air pollution on asthma exacerbations in children and adults: Systematic review and multilevel metaanalysis. 2017 PLOS.

Orser, Edward (1990) Secondhand Suburb. Journal of Urban History

Orser, Edward (2015) Blockbusting in Baltimore: The Edmondson Village Story. The University Press of Kentucky.

Osborne, N., Alcock, I., Wheeler, B., Hajat, S., Sarran, C., Clewlow, Y., & ... Fleming, L. (2017). Pollen exposure and hospitalization due to asthma exacerbations: daily time series in a European city. International Journal Of Biometeorology, 61(10), 1837-1848. doi:10.1007/s00484-017-1369-2

Ouazad Amine (2011) Blockbusting: Brokers and The Dynamics of Segregation.

Outka, Uma. (2017) Fairness in the Low-Carbon Shift LEARNING FROM ENVIRONMENTAL JUSTICE, Brooklyn Law Review.

Pacheco, Christina. Christina E. Ciaccio, Niaman Nazir, Christine M. Daley, Anita DiDonna, Won S. Choi, Charles S. Barnes, and Lanny J. Rosenwasser. Homes of low-income minority families with asthmatic children have increased condition issues. Allergy Asthma Proc. 2014 Nov-Dec; 35(6): 467–474. doi: 10.2500/aap.2014.35.3792

Papaioannou, A. I., Bartziokas, K., Loukides, S., Papiris, S., & Kostikas, K. (2014). Exercise Induced Bronchoconstriction: A clinical approach. Pneumon, 27(2), 131-146

Pastor M Jr, Sadd JL, Morello-Frosch (2004) Waiting to Inhale: The Demographics of Toxic Air Release Facilities in 21.sup.st.sup.-Century California. Soc Sci Quart 2004, 85: 420-440

Patel, S., & Gruchalla, R. (2017). Can We Be Too Clean for Our Own Good? The Hygiene Hypothesis Reviewed. Texas Medicine, 113(2), 54–59. Retrieved from http://proxy.binghamton.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=mnh&AN=28207081&site=ehost-live

Patten, Eileen. (2016) Racial, gender wage gaps persist in U.S. despite some progress. Copyright 2019 Pew Research <https://www.pewresearch.org/fact-tank/2016/07/01/racial-gender-wage-gaps-persist-in-u-s-despite-some-progress/> Accessed April 2019

Pavot W and Diener E (1993) Review of the Satisfaction with Life scale. Psychological Assessment 5:164–172.

Pellow, D. N. (2000). Environmental Inequality Formation. American Behavioral Scientist, 43(4), 581

Perlin Susan, Setzer Woodrow, Creason John, Sexton Ken.(1995) Distribution of Industrial Air Emissions by Income and Race in The United States: An Approach Using the Toxic Release Inventory. Environmental Science Technology

Perlin, Susan. Setzer Woodrow. (1995) Distribution of Industrial Air Emissions by Income and Race in The United States: An Approach Usings the Toxic Release Inventory. 1995 Environ. Sci. Techno/.

Perera, Frederica. (2017) Multiple Threats to Child Health from Fossil Fuel Combustion: Impacts of Air Pollution and Climate Change . 2017. Environmental Health Perspective

Polyzoi, E., Polyzois, D., & Koulis, T. (2017). Presence of Household Mold, Children's Respiratory Health, and School Absenteeism: Cause for Concern. Journal Of Environmental Health, 79(7), 28-35

Pope, Ronald. Wu, Jianguo. Boone,Christopher. (2016) Spatial patterns of air pollutants and social groups: a distributive environmental justice study in the phoenix metropolitan region of USA. 2016. Environmental Management (2016) 58:753–766 DOI 10.1007/s00267-016-0741-z

Press. Hyra, D., and S. Prince. (2015) Capital dilemma: Growth and inequality in Washington, D.C. London and New York: Routledge.

Pulido, L. (2000). Rethinking environmental racism: White privilege and urban development in Southern California. Annals of the Association of American Geographers, 90(1), 12–40.

Ramo, Alan. (2000) Book Review: The Promise and Peril of Environmental Justice. By Christopher H. Foreman, Jr. Golden Gate University of Law. 40 Santa Clara L. Rev. 941 (2000)

Ranson, Matthew. The Impact of Pollution Prevention on Toxic Environmental Releases from U.S. Manufacturing Facilities. 2015. Environ. Sci. Technol.

Rapkin Chester and Grigsby William G. . Residential Renewal in the Urban Core: An Analysis of the Demand for Housing in Center City Philadelphia, 1957-1970 with Reference to the Washington Square East Redevelopment Area. Pp. 131. Philadelphia : University of Pennsylvania Press, 1960

Rose, Carol. Brooks, Richard. (2013) Saving the Neighborhood: Racially Restrictive Covenants, Law, and Social Norms. Harvard University Press

Rose, Carol. (2016) Racially Restrictive Covenants- Were they Dignity Takings? Law & Social Inquiry Volume 41, Issue 4, 939–955. Journal of The American Bar Foundation.

Rutan, D. Q., & Glass, M. R. (2018). The Lingering Effects of Neighborhood Appraisal: Evaluating Redlining's Legacy in Pittsburgh. Professional Geographer, 70(3), 339–349. https://doi-org.proxy.binghamton.edu/10.1080/00330124.2017.13

Ryan RM and Deci EL (2001) On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. Annual Review of Psychology 52: 141–166.

Ryff CD, Singer BH and Love GD (2004) Positive health: Connecting well-being with biology. Philosophical Transactions of the Royal Society B 359: 1383–1394.

Ryff CD and Singer BH (2008) Know thyself and become what you are: A eudaimonic approach to psychological well-being. Journal of Happiness Studies 9: 13–39.

Schindler Sarah, Architectural Exclusion: Discrimination and Segregation through Physical Design of the Built Environment, 124 Yale L. J. 1934 (2015).

Sharkey, P. 2013. "Stuck in place. Chicago: Chicago University Press
Shelley et ux. V. Kramer et ux. 1948. 334 U.S.1; 68 S. Ct.836; 92 L. Ed. 1161 (May 3)

Shlay, A. B. (1988). "Not in That Neighborhood: The Effects of Population and Housing on the Distribution of Mortgage Finance Withing the Chicago SMSA." Social Science Research, 17(2), 137-163.

Shlay, A. B. (1989). "Financing Community: Methods for Assessing Residential Credit Disparities, Market Barriers, and Institutional Reinvestment Performance in the Metropolis." Journal of Urban Affairs, 11 (3), 201-223.

Silverman, Robert Mark. "Redlining in a majority Black city?: mortgage lending and the racial composition of Detroit neighborhoods." *The Western Journal of Black Studies* 29, no. 1 (2005): 531+. *Academic OneFile* (accessed November 10, 2018)

Sen A, Smith TE: Gravity Models of Spatial Interaction Behavior New York, NY: Springer; 1995.

Sheppard ES: The distance-decay gravity model debate. Spatial Statistics and Models Edited by: Gaile GL, Willmott CJ; Boston, MA: D. Reidel Publishing Company; 1984: 367-388.

Sheppard, Eric. Leitner Helga , McMaster, Robert. Tian, Hongguo. GIS-based measures of environmental equity: Exploring their sensitivity and significance. 1999. Journal of Exposure Analysis & Environmental Epidemiology.

Shultz, Amy.Schauer, Jamie. and Malecki, Kristen. 2017. Allergic disease associations with regional and localized estimates of air pollution. Environmental Research 155 (2017) 77–85

Sideleva, O., Black, K., & Dixon, A. E. (2013). Effects of obesity and weight loss on airway physiology and inflammation in asthma. Pulmonary Pharmacology & Therapeutics, 26(4), 455-458. doi:10.1016/j.pupt.2012.05.002

Sacoby Wilson, , Herb Fraser-Rahim, Edith Williams, Hongmei Zhang, LaShanta Rice, Erik Svendsen, and Winston Abara. .Assessment of the Distribution of Toxic Release Inventory Facilities in Metropolitan Charleston: An Environmental Justice Case Study. American Journal of Public Health | October 2012, Vol 102, No. 10

Sacoby, Wilson. Assessment of the Distribution of Toxic Release Inventory Facilities in Metropolitan Charleston: An Environmental Justice Case Study. 2012. American Journal of Public Health.

Sacoby, Wilson. Being overburdened and medically underserved: assessment of this double disparity for populations in the state of Maryland. 2014. Environmental Health.

Spira-Cohen Ariel, Chen Lung, Michaela Kendall, Lall Ramona. Personal exposures to Traffic Related Air Pollution and Acute Respiratory Health among bronx schoolchildren with Asthma . 2011 Environmental Health Perspective.

Stoner, Alexis M. , Sarah Anderson, and Timothy Buckley. Ambient Air Toxics and Asthma Prevalence among a Representative Sample of US Kindergarten-Age Children, 2013. Public Library of Science.

Svanes, C., Dharmage, S., Sunyer, J., Zock, J. P., Norbäck, D., Wjst, M., & ... Antó, J. M. (2008). Long-term reliability in reporting of childhood pets by adults interviewed twice, 9 years apart. Results from the European Community Respiratory Health Survey I and II. Indoor Air, 18(2), 84-92. doi:10.1111/j.1600-0668.2008.00523

Stapinski, Helene. "Buyer beware: a history of redlining and racism in Chicago." *Columbia Journalism Review* 47, no. 6 (2009): 56+. *Academic OneFile* (accessed November 10, 2018

Taeuber, K. E. & Taeuber, A. F. (1965). Negroes in Cities: Residential and Neighborhoo d Change. Chicago, IL: Aldine Publishing Company.

Taub, R. P., Taylor, D. G., & Dunham, J. D. (1984). Paths of Neighborhood Change: Race and Crime in Urban America. Chicago; London: The University of Chicago Press.

Taylor, Dorceta. Toxic Communities: Environmental racism, Industrial Pollution and Residential Mobility. (2014) New York University Press.

Taylor B, Mannino D, Brown C, Crocker D, Twum-Baah N, Holguin F. Body mass index and asthma severity in the National Asthma Survey. Thorax. 2008;63:14–20.

Tétreault Louis-Francois, Marieve Doucet, Philippe Gamache, Michel Fournier, Allan Brand, Tom Kosatsky, and Audrey Smargiassi. Childhood Exposure to Ambient Air Pollutants and the Onset of Asthma: An Administrative Cohort Study in Québec. 2016. Environmental Health Perspective.

Tiberius V (2004) Cultural differences and philosophical accounts of well-being. Journal of Happiness Studies 5: 293–314.

Trudeau, Daniel. (2006) The Persistence of Segregation in Buffalo, New York: Comer VS.Cisneros and Geographies of Relocation Decisions Among Low-Income Black Households, Urban Geography, 27:1, 20-44, DOI: 10.2747/0272-3638.27.1.20. “Used with permission”.

Tzivian L. Outdoor air pollution and asthma in children. J Asthma 2011;48:470-81.

United Church of Christ. 1987. Toxic Race and Waste: A National Report on the Racial and Socio-Economic Characterist!cs of Communities with Hazardous Waste Sites. COMMISSION FOR RACIAL JUSTICE United Church of Christ ©1987. https://www.nrc.gov/docs/ML1310/ML13109A339.pdf

U.S. Census Bureau. Quickfacts: Buffalo, NY. Retrieved from https://www.census.gov/quickfacts/buffalocitynewyork

U.S. Environmental Protection Agency. Toxic Release Inventory. Facility data (2017) Accessed April 2019. < https://iaspub.epa.gov/triexplorer/tri_quantity.facility>
US Environmental Protection Agency, Washington, DC, 2018. [http:// www.epa.gov/toxics-release-inventory/tri/program/].

Van Houten Bennett, Santa-Gonzalez Gloria, Camargo Mauricio,(2018) DNA repair after oxidative stress: Current challenges. Current Opinions on Toxicology

Van Tilburg Bernardes, E., & Arrieta, M.-C. (2017). Hygiene Hypothesis in Asthma Development: Is Hygiene to Blame? Archives Of Medical Research, 48(8), 717–726. https://doi-org.proxy.binghamton.edu/10.1016/j.arcmed.2017.11.009

Weinberg, A. 1998. The environmental justice debate: A commentary on methodological issues and practical concerns. Sociol. Forum 13(1):25–32.

Williams-Myers, A.J. (2003) The Underground Railroad in the Hudson River Valley: a succinct historical composite. Afro-Americans in New York Life and History. 27.1 (Jan. 2003): p55+.Copyright: COPYRIGHT 2003 Afro-American Historical Association of the Niagara. Frontier, Inc.

Williams, David. Collins, C. Racial residential segregation: a fundamental cause of racial disparities in health. Public Health Rep. 2001 Sep-Oct; 116(5):404-16.

Williams, David. Michelle Sternthal. Rosalind J. Wright. Social Determinants: Taking the Social Context of Asthma Seriously. Pediatrics. 2009 Mar; 123(Suppl 3): S174–S184.
doi: 10.1542/peds.2008-2233H National Institute of Health.

Wood Peter, Lee Barrett. (1991) Is Neighborhood Racial Succession Inevitable: Forty Years Evidence. Urban Affairs Quarterly

Wolf, E. P. (1963). The Tipping-point in racially changing neighborhoods. Journal of the American Planning Association, 29(3), 217-222.

Wood, P. B. & Lee, B. A. (1991). Is neighborhood racial succession inevitable? Forty

years of evidence. Urban Affairs Review, 26, 610-62.

Woodfolk, J. A., Glesner, J., Wright, P. W., Kepley, C. L., Mi, L., Himly, M., & ... Pomés, A. (2016). Antigenic Determinants of the Bilobal Cockroach Allergen Bla g 2. Journal Of Biological Chemistry, 291(5), 2288-2301. doi:10.1074/jbc.M115.702324

Wyly, E. K. and S. R. Holloway. (1999). "'The Color of Money' Revisited: Racial Lending Patterns in Atlanta's Neighborhoods." Housing Policy Debate, 10(3), 555-600.

Zandbergen Paul and Jayajit Chakraborty, Methodology Open Access Improving environmental exposure analysis using cumulative distribution functions and individual geocoding. 2006. International Journal of Health Geographics.

Zeliger H. (2016) Predicting disease onset in clinically healthy people. Interdisciplinary Toxicology