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EVALUATING DISPARITIES IN QUALITY OF LIFE IN THE CITY OF ATLANTA USING AN URBAN HEALTH INDEX

by

KARLA A. ILIC

Under the Direction of Dajun Dai

ABSTRACT

Measuring disparities in Quality of Life (QOL) can be challenging due to the vast amount of factors to be included. This study attempts to measure disparities in QOL using a newly developed Urban Health Index (UHI). Using 128 census tracts in City of Atlanta in Georgia as an example, this study selects six variables that are related to QOL. Their geometric mean is then used to construct a single numeric value for each census tract. The QOL disparity ratio is then determined by the upper and lower 10% of the data. The slope of disparity is calculated using the remaining 80% of the data. The results show that urban health index may be an affective indicator of QOL in a city.

INDEX: Urban health index, GIS, Quality of life

EVALUATING DISPARITIES IN QUALITY OF LIFE IN THE CITY OF ATLANTA USING AN URBAN HEALTH INDEX

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KARLA A. ILIC

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2013

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2013

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by

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Electronic Version Approved:

Office of Graduate Studies

College of Arts and Sciences

Georgia State University

August 2013

DEDICATION

I dedicate this to all those who have helped me to get here. Thank you for all your energy and efforts.

ACKNOWLEDGEMENTS

I would like to give proper respect to Dr. Dajun Dai for all of his tireless efforts in helping me complete this project. I can truly say it was time well spent in his presence, resulting in me becoming a better person. I am grateful for his time and attention.

I also appreciate the time and energy of the committee members, Dr. Jeremy Diem and Dr. Richard Rothenberg. I know that both are very busy individuals and offer gratitude to them for helping me with this thesis.

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1 INTRODUCTION

Quality of Life is a complex multifaceted issue that encompasses many partnerships among government agencies, policy makers, and medical health professionals. All of these individuals have a common goal of lifespan expansion through identification and prevention of health deterrents. The challenge lies in how to measure Quality of Life. Variables that relate to the physical environment and socio-economic background of the population, both positive and negative, can be studied with the added geographic component through the use of Geographic Information Systems (GIS) in turn lending to a broadening in the understanding of the Quality of Life in Atlanta. Variables can be examined statistically and mapped; then compared to known information, like the Urban Health Index with seven variables (UHIv7), which a research group of scholars created to measure and assess an areas residential experience based upon a health metric (Rothenberg et al 2011; Rothenberg et al 2012).

UHIv7 at its core seeks to develop a manner in which to measure health disparities within a given area through the use of statistical methods that can be implored for future planning and development needs (Rothenberg et al 2011). In particular, Rothenberg et al. picked seven indicators of positive attributes, (a) % of population with bachelor's degree or higher, (b) % of employed,(c) median household income, (d) mean household income, (e) % high school graduates, (f) % above poverty level, (g) % of household not headed by a single female with children under 18 years old, at the census tract level for their project basis (2011, 2012). Indicator variables were chosen that are in alignment with a positive relationship thus suggesting a higher UHIv7 value to be associated with a better Quality of Life. They also determined the health disparity ratio; the units of the index were ranked in their order opposite of their UHIv7 value. The distribution among the graphed indicators showed a health disparity experienced by the lowest UHIv7 ranked tracts. The researchers approached the health disparity by comparing the upper and lower ten deciles and then use OLS linear regression to measure slope variances using the remaining 80% of the data in the middle.

Also to be considered is the impact that negative indicators could have on the Quality of Life. Traditional negative indicators typically focus on health deterrent rates which are bore out of a medical basis, such as lack of proper sanitation, disease, and mortality rates. Two negative environmental indicators, Georgia Environmental Protection Division Brownfields and child molesters, are mapped by geographic coordinates and are overlain on each the UHIs choropleth maps. The spatial distribution of each negative indicator is relevant to Quality of Life.

This study sought to answer the following questions: What will be the alignment between the UHIv7 and this study's UHIs? Will the maps hold any spatial correlations? Will the negative indicators have a higher frequency within the lower UHI values? The goal of this study is to broaden the knowledge about the Quality of Life experienced by the city of Atlanta residents. The study objective is to denote any spatial relationships between newly introduced and previously used indicator variables that could have a positive impact on future local policy planning.

2 LITERATURE REVIEW

The Centers for Disease Control and Prevention define Quality of Life as all factors that affect the daily lives of individuals, both positive and negative influences, that are used to access an area (CDC TWO 2011). Examples of Quality of Life positive environment indicators are a low percentage of heart attacks, obesity, or smoking within a study area. Negative Quality of Life factors are a high number of suicide incidents, high mortality rates, or a high prevalence of substance abuse. Quality of Life is a measurement that seeks to encompass multiple categories each bearing specific criteria for variable selection and explanation of relevance (CDC TWO 2011).

Quality of life is difficult to define due to the vast amount of factors to be considered that are relevant because their basic function is to create the healthiest possible living environment (Turnock 2004). Local policies and health standards are monitored and maintained by public health agencies which at times can have controversial means of regulation implementation (Glaeser 2012). Invasion of personal privacy is a topic with much interest and emphasis placed upon it in the public health arena (CDC ONE 2012). Scope of authority for public health agencies is placed under scrutiny on a local, national, and continental due to the interconnectivity of many public health concerns that allow for ease of dispersion (Baker, Potter et al. 2005; Brown and Moon 2012). Arguments are made for incarceration to be considered a public health issue because of the extent of the disparities created from social polarization to decreased income levels (Massoglia 2008). When thinking about public health, it is not unnatural to first consider the local physical environment because quality of life is directly impacted by the physical environment of the population.

Physical environment refers to the built environment along with the land, water, and air surrounding it (CDC TWO 2011). The built environment encompasses all of the man-made structures like homes, businesses, and roads. With considerations of public health and safety, building codes are in place to maintain and create the built environment. When economic hardship engulfs an area, the built environment begins to decay. More and more studies are linking negative characteristics of the built environment with negative health impacts, such as residential locations in close proximity to high travel roads have higher rates of asthma and breathing problems (Setton, Keller et al. 2008; Dhondt, Beckx et al. 2012).

Air and water quality are very important factors of the physical environment. Air quality is another component of interest because the rate of air pollution as measured by elevated smog days is highly correlated to negative health outcomes (Dominici, Peng et al. 2007; Lipfert and Murray 2012). One study recognized a potential twenty percent reduction in fine particulates that could yield as much as a thirty percent reduction in short term deaths associated with this type of air pollution (Baccini, Biggeri et al. 2011). Due to cyclical and interconnectivity of biospheres, air relates to water. Water quality has a major impact on the local residents and the public health implications were recognized long ago in 1854 by John Snow with his cholera and water spatial relationship discovery (USEPA ONE 2012). Water contaminates such as arsenic leftover from industrial usage or pharmaceutical wastes have had severe bearings on the local residents, according to multiple studies due to the negative amount of health outcomes (Hascic and JunJie 2006). Water quality also effects the property values, causing them to decrease (Walsh, Milon et al. 2011). Unfortunately often times, when the water has been injected with a hazardous substance, the hazardous material will seep into the soil. Referring back to biospheres and connectivity, soil interacts with air and water.

Soil quality is an important variable due to its ability to hold contaminates. Chemicals such as arsenic are dispersed by the water into the soil to result in unhealthy living environment (Ryker 2003; Fick, Soderstrom et al. 2009). Some government agencies, such as the GAEPD, maintain a listing of identified hazardous sites at point locations that also monitors site remediation. Some brownfields are listed on hazardous site inventory also (GAEPD ONE 2012). This type of information is highly relevant to urban redevelopment because notions of actual or perceived contamination will squash revamping due to the fact that the community will not reuse the property (Seaman, Jones et al. 2010; Wang, Fang et al. 2011). When thinking of soil quality, ideas of land cover types arose especially with thoughts of green land cover class types.

Environmental Quality of Life indicators considers air, water, and soil qualities along with greenspace access (Abercrombie, Sallis et al. 2008; Lo and Jim 2010; Dai 2011). Abercrombie noted within her study two disparities, racial and income, which coincided with lack of access to parks or greenspaces (2008). Dai's study reflected similar findings with the brunt of lack of access to greenspaces falling upon a majority of minority population, African-Americans (2011). A different study also notes the lack of physical activity which can contribute to higher obesity rates due to not having an area suitable for walking (Lo and Jim 2010).

While exploring variables that relate to Quality of Life assessments, transportation access is included and is deemed highly important because a lack of mobility can greatly hinder employment opportunities (David 2012). Along with restricted movement, one study gained a better understanding of the experience of how residents used the transportation system so that adjustments can be made that directly affects the Quality of Life (Carse 2011). Transportation affects the community either positively or negatively, be it either several choices that are economically viable for all residents or a lack of transportation access. Continuing forward with the idea of negative community assets, GAEPD brownfields and child molesters are explored next.

As many urban areas are experiencing a sprawling metropolitan development that is coupled with a growing population, the need to maximize all urban space is high. Any underutilized structures or properties should be considered for redevelopment including brownfields. The United States Environmental Protection Agency (USEPA) defines a brownfield as any unused property that has the potential to be polluted with hazardous substances (USEPA TWO 2012). The area and contents of brownfield locations vary greatly; a small lot may be less than half of an acre but larger lots can be over one hundred acres. Some brownfield locations do not have buildings or any type of physical structure (USEPA TWO 2012). Brownfields can be occupied; they are not exclusively vacant, but they do warrant some of the same distresses surrounding vacant properties (Accordino and Johnson 2000). Issues surrounding brownfields are of high concern to many citizens because they impact the daily lives of the community members (Hollander 2010). Personal safety, crime, and public health are all related to the Quality of Life experienced by residents (Accordino and Johnson 2000).

Brownfields and hazardous sites have a direct impact on the local economy and should be included in the Quality of Life study. With proper remediation a portion of these sites could be revamped into any number of different end uses, such as greenspaces, mixed-use with commercial and residential availabilities (Chen, Hipel et al. 2009; Adelaja, Shaw et al. 2010; Pearsall 2010). One major area of consideration with brownfields and hazardous sites is the cost of site remediation; the expense of construction and disposal materials must be carefully considered often times creating a barrier to restoration (Wedding and Crawford-Brown 2007; Hula and Bromley-Trujillo 2010; Wang, Fang et al. 2011).

The origin of brownfields is linked to the local economy, which in turn is related to employment rates (USEPA TWO 2012). The nature of the capitalism allows for dynamic changes that helps or hinders the local economy (Harvey 2010); this is an important impact because people follow jobs. As businesses relocate for any number of reasons, left behind are buildings and property lots, some will be quickly reused or redeveloped but not all. As time passes with no revamping of the empty lot, many times over the lot and surrounding area become derelict (Saginor 2011). Poverty has become one of the identifiers of brownfields (Lee 2010). Coupled with decaying built environment is a declining social situation with many residents unemployed, their sense of personal wellbeing falters (Kim, Baum et al. 2011) resulting in increases in substance abuse and violence (Pearsall 2010).

Community assets should be reflected upon to evaluate their contribution to the local environment (Pan, Littlefield et al. 2005; Tappendorf and Denzin 2011). Fire stations, libraries, and hospitals are only a few community assets that could easily influence Quality of Life and UHI. Assets Based Community Development is an area of interest for Quality of Life due to the fact that input is elicited from the community in an attempt to structure future urban planning tailored for its residents (Mathie and Cunningham 2005). Engaging with the community to determine their needs as perceived by them allowed for a successful partnership in the highly urban setting of South Chicago, between urban planners and local residents (Lindau, Makelarski et al. 2011).

Crime rates affect the Quality of Life negatively because high crime rates are associated with a declining social situation that can lead to a barrage of any other undesirable activities (Latkin and Curry 2003; Lee 2011). A long standing association of crime are vacant lots which in some instances are perceived fears while other concerns are very real and highly evident (Hollander 2010). Foreclosures that lead to vacant lots can be correlated to an increase in crime rates in some urban areas (Stucky, Ottensmann et al. 2012). While another study associates crime increases with forecloses but specifically robbery crimes (Baumer, Wolff et al. 2012). Unfortunately as crime rates increase, the number of youth offenders increases as well resulting in higher delinquency rates (Mennis, Harris et al. 2011). Higher rates of incarceration will also follow with crime increases which have a devastating effect on the Quality of Life for many families (Geller, Garfinkel et al. 2009; Celinska and Siegel 2010) and on the children of the incarcerated (Murray and Farrington 2008).

Another negative quality of life factor is registered sexual offenders. The motivating point that tips the scale for many neighborhoods is their fear of re-offense (Ackerman 2011). One study also reports on the amount of fear experienced in neighborhoods by knowledge of a child sexual offender released back into the community (Kernsmith, Craun et al. 2009). Another study relates the innate attitude of most residents of intolerance for and complete lack of desire to be in any type of close proximity to those registered offenders (Burchfield and Mingus 2008). Information dissemination into the community is critical to protecting the rights of all residents (Craun 2010; Ackerman, Harris et al. 2011). This particular portion of the population has very restrictive guidelines in place concerning the location of their residence in relation to other more vulnerable residents (Grubesic, Mack et al. 2007). Registered sexual offender locations tend to be clustered in most urban areas (Grubesic 2010).

Geographic Information Systems are comprised of computer hardware and specialized software that generates maps along with performing a wide variety of calculations (ESRI 2012). Datasets for GIS are typically in spreadsheet format that allows a user to input variables with a spatial component that provides a new way to view the dataset when all variables are input and a new map generated. The ability of GIS to create new information is highly desirable (Chen, Yu et al. 2010), because this can lead to new analysis of the dataset (ESRI 2012). GIS has been used before to evaluate many factors around brownfields, such as, air quality, proximity to transportation, and educational levels (Thomas 2002). More recent studies have used GIS to identify spatial patterns, “clustering”, of registered sexual offenders to reside very close to one another within a community mostly due to legislation (Grubesic 2010). The City of Atlanta needs to be studied with thoughts of different variables to create an UHI that contributes to the overall understanding of the Quality Of Life of its residents and an UHI that is used for comparative purposes to UHIv7.

Network Analyst tool in ArcMap allows for creation of service area polygons around point locations and is often used to create buffers due to their highly detailed nature (ESRI 2012). The logic behind this choice is that the service areas viewed as a whole can show an immediate cover or lack thereof. Service area polygons are centered on each location with a five minute drive time at posted speed limits. This distance and time determinate is based on a report from the National Fire Protection Association that found the need for four minute time lapse from time the distress call was received to time on fire fighters arrive on scene (Flynn 2009).

Highly related to quality of life measures is the Urban Health Index (UHIv7) created by Rothenberg et al. (2012). The UHIv7 is a combination of factors such as percentage of not female headed households and number of households with bachelor's degree or higher, that lends to the extension of the assessment of the Quality of Life in an area (2012). The information of the UHIv7 results in a numerical value assigned to each census block ranking it from one to zero with values closer to one being the better living environments (2012). Overlaying new variables, brownfields or child molesters, further enhances our knowledge of the Quality of Life. All of these components considered statistically and placed together visually should show any spatial relationships that can ultimately show health disparity or lack thereof.

The UHIv7 researchers sought to abide by several ideals, one: the dataset used has to be transparent and accessible for a wide array to the populous, two: the metric used to complete the study was to be thoughtful, considerate, and relevant, three: the interchangeability of indicators. For future studies, UHIv7 researchers detailed their continuing diligence in the further development of an Urban Health Index. The study area of the UHIv7 is also City of Atlanta making for ease of integration of research.

The Urban Health Index (UHIv7) took datasets for seven indicators to be further described in detail in data and methodology section, and began with standardization of each variable. Then amalgamation was done, and ultimately the geometric mean was used as the main assessor and mapped. Mapping the geometric means showed a clear disparity in the City of Atlanta especially for the residents within a narrow band that reaches out from the downtown area that has the lowest UHIv7 scores. By incorporating the spatial component, the dataset shows the experience in a manner that pure empirical data could not. UHIv7 is represented in Figure 1 below, with the lighter hues having a better Quality of Life based upon the variables used to generate the index. The upper most portion of the city has be highest UHIv7 scores indicating a better Quality of Life for those individuals.

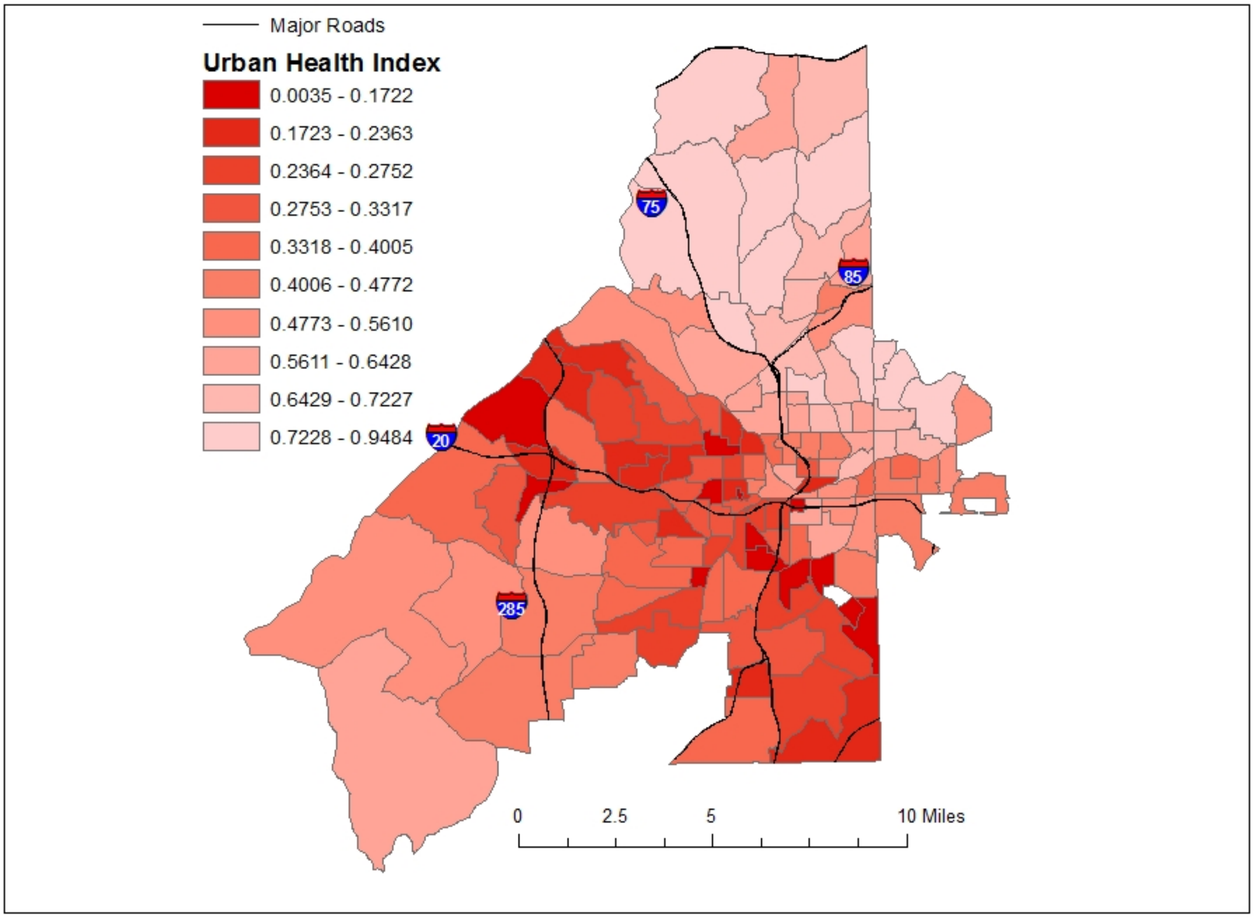

Figure 1 Urban Health Index (UHIv7)

In order to determine any health disparity, the extremes of the UHIv7, the upper and lower ten percent deciles of the Index are considered, less than 0.172228 and greater than 0.722663, in Figure 2. These two groups are important to consider because one group reaps the most benefits from its community while the other group has the worst benefits.

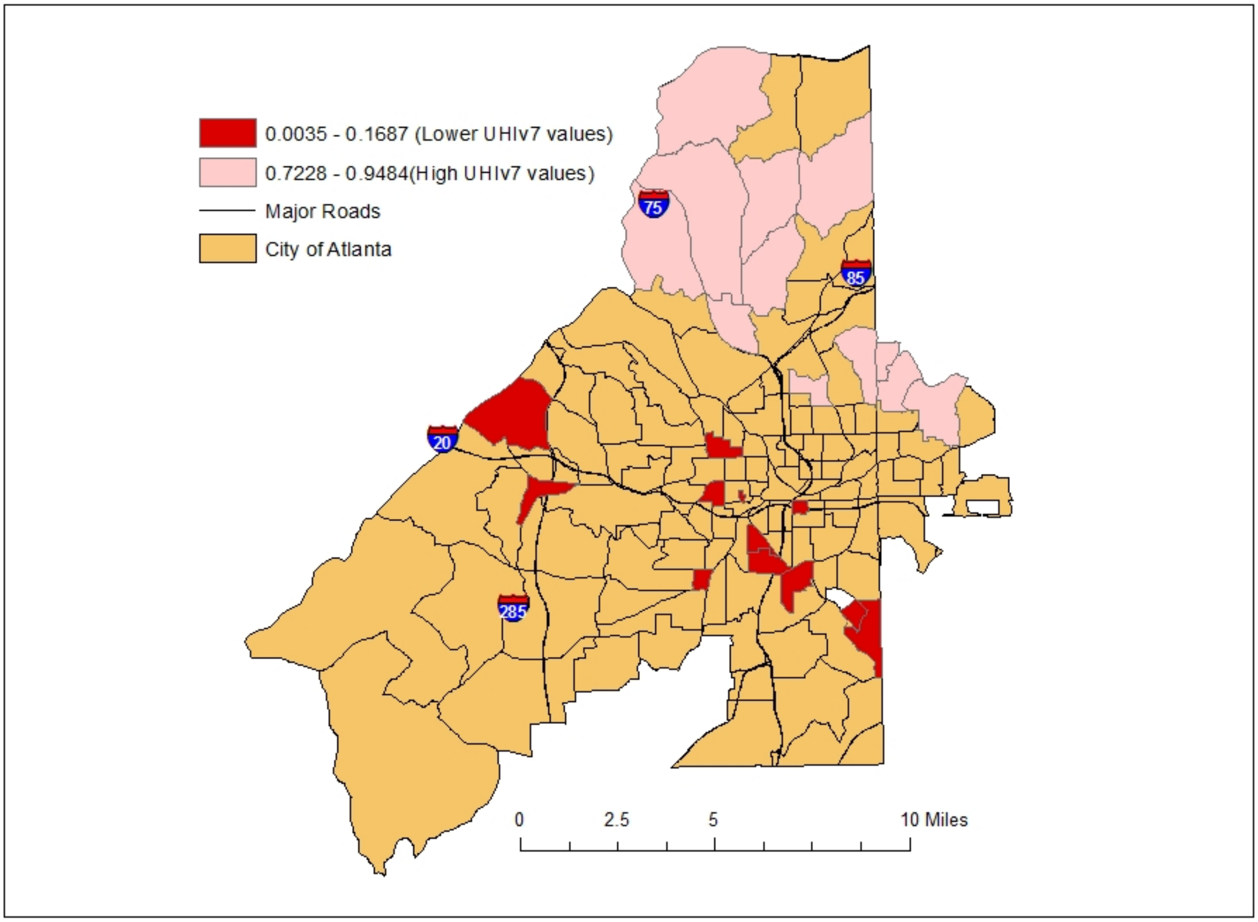

Figure 2 UHIv7 Upper and Lower Extremes

OLS regression was utilized by Rothenberg et al to get the slope of the midsection of the Index. Figure 2 offers a better look at the upper and lowers ten percent deciles of the UHIv7 (2011, 2012). Table 1 shows a breakdown of UHIv7 with respect to the community assets and liabilities. Both the upper and lower ten percent deciles both hold twelve census tracts. The total area for the tracts varied tremendously, UHIv6 upper (32.37 mi^2) and UHIv7 lower (7.29 mi^2). The lower 10% of UHIv7 has 8 community assets with the upper 10% having 11. The total number of vacancies are highly similar, roughly 20,000, in both the upper and the lower UHIv7 ten percent. But when the area of UHIv7 is factored into the vacancy numbers; the result has 622 vacancies per mi^2 for UHIv7 upper and 2,677 vacancies per mi^2 for UHIv7 lower percentage. The community liability of child molesters contains 1 resident in the UHIv7 upper ten percent of the Index, with UHIv7 lower having 11. The means are quite different (0.811 and 0.13). Having calculated the geometric means, it is possible to determine the health disparity ratio by dividing UHIv7 upper ten percent mean by the UHIv7 lower ten percent mean to achieve the single numeric value of 5.96. Figure 3 shows the rank order of the midsection of UHIv7. The health disparity slope was 0.54. A histogram of UHIv7 is offered, Figure 3.

Table 1UHIv7 Service Breakdown

UHIv7	Upper 10%	Lower 10%
Number of Census Tracts	12	12
Total Area (mi^2)	32.374868	7.289426
UHIv7 Mean	0.811356	0.132706
UHIv7 Standard Deviation	0.056077	0.046369
Fire Stations	6	4
Police Stations	0	1
Libraries	2	3
Hospitals	2	0
Emergency Rooms	1	0
Vacancy 2010	20,150	19,517
Vacancy/Area Square Miles	*622*	2,677
Brownfields	*9*	*2*
Child Molesters	*1*	*11*

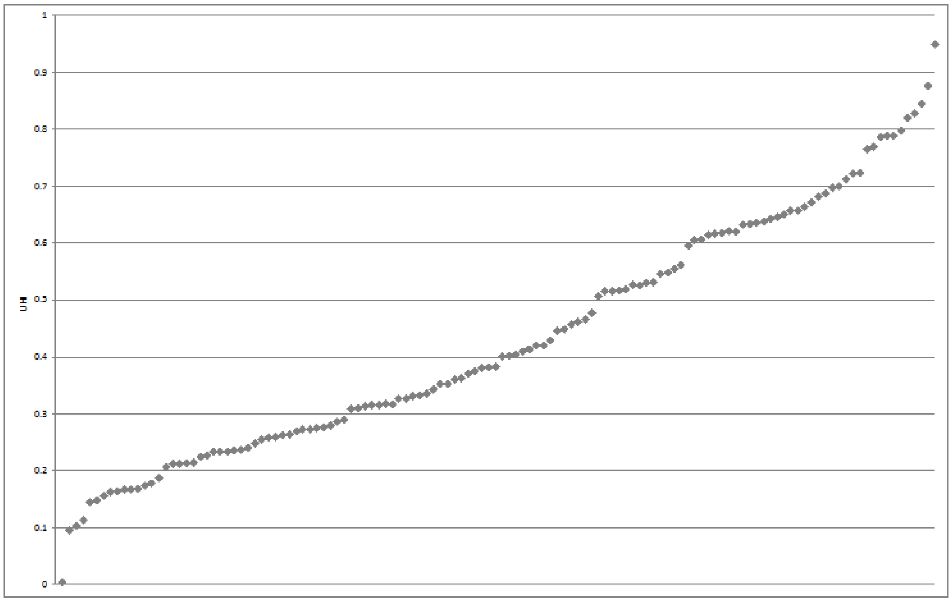

Figure 3 UHIv7 Rank Order of Midsection

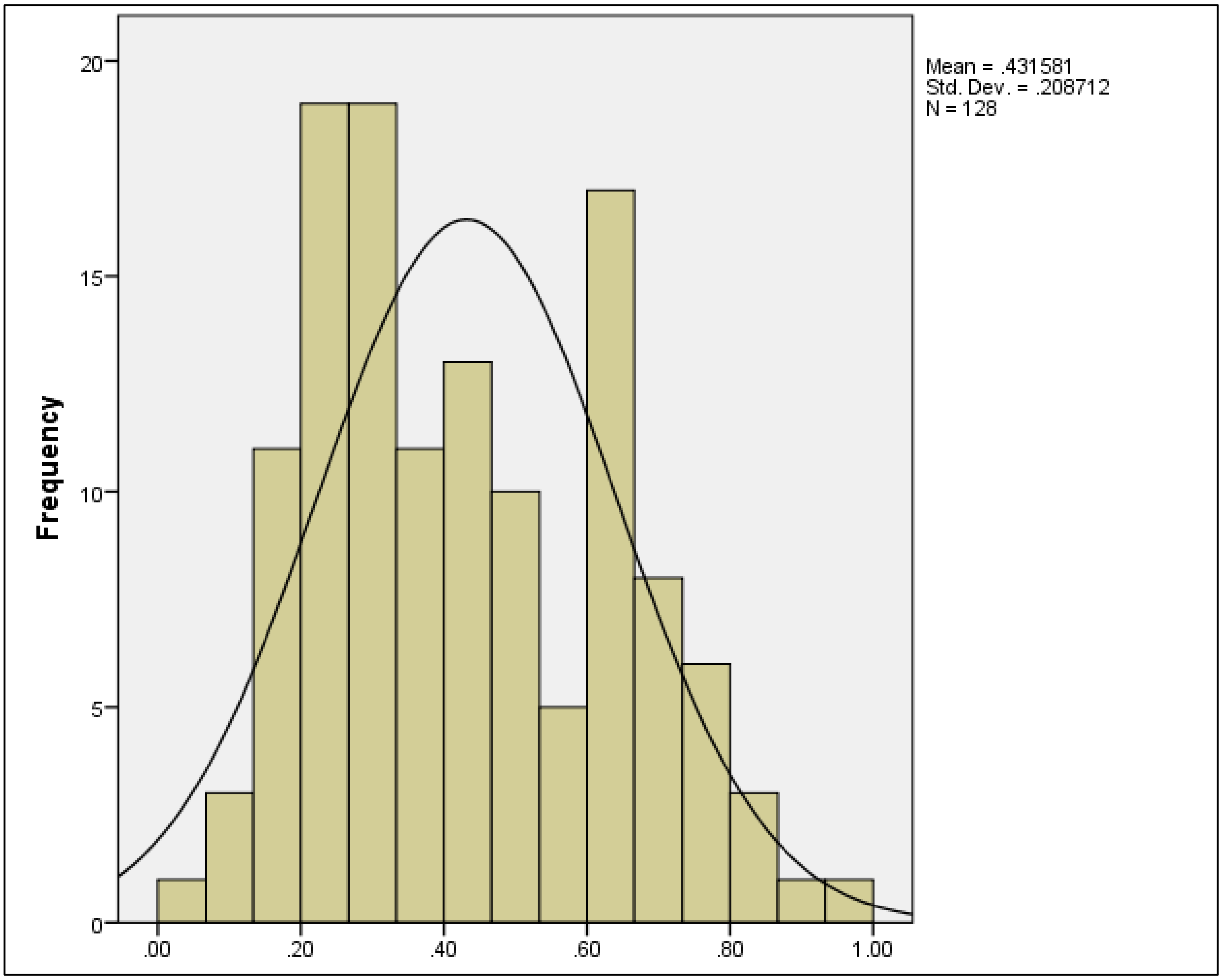

Figure 4 Histogram of UHIv7 Distribution

Inspired by the development of UHIv7 this study takes into consideration different variables, hospitals, libraries, fire, and police station service areas, percent not vacant, along with brownfields and child molesters. The location of child molesters has been reviewed lightly; but not for the City of Atlanta. These variables are included because the dispersion patterns of each need to be explored. These thesis questions, what is the spatial coincidence between the UHI and quality of life experienced by the residents. This is significant because it will determine areas of the city that are underserved or that have lower high numbers of negative quality of life factors.

3 DATA AND METHODS

3.1 Data

The study area is the City of Atlanta, GA. From the Atlanta Regional Commission's GIS webpage, http://www.atlantaregional.com/info-center/gis-data-maps/gis-data , census boundary files, major roads, and community facilities, contains libraries, police stations, hospitals and other locations (ARC 2012). My thesis advisor provided the original UHIv7 file including the seven variables used to calculate the index, (a) % with bachelor's degree or higher; (b) % high school graduates or higher; (c) % above poverty level; (d) % employed; (e) % of household not headed by a single female with children under 18 years old; (f) household mean income; and (g) household median income.

Census data was collected from the United States Census Bureau's webpage, http://www.census.gov/2010census/. This dataset was necessary to gain an understanding of the population. Some examples of these types of information are: number of vacant properties as compared to total number of properties. The same is true for the ethnicity breakdown; all are relative for this study to understand the demographics.

A list of brownfield locations was obtained from the Georgia Environmental Protection Division's webpage, http://www.gaepd.org/Files_PDF/outreach/BFList.pdf (GAEPD TWO 2012). The dataset consisted of lot size and if the site was also placed upon the Hazardous Sites Inventory. This dataset provides a way to examine brownfield locations as its spatial coincidence with the Quality of Life suggested by UHIv7. One of the drawbacks to this dataset is that it does not contain all of the brownfield sites in the city; there is no single data source to keep a complete list of the brownfields.

Registered sexual offender locations are available online through the Georgia Bureau of Investigation at http://gbi.georgia.gov/georgia-sex-offender-registry (2012). After reviewing the GBI dataset, child molesters were chosen due to their category having the most complete physical address listings.

3.2 Methods

3.2.1 Census Data

Census data collected was compared by figuring the percentage of ethnicity by total population and vacancy rates (US census 2010 data). To stay in a positive variable alignment Vacant was recalculated as Not Vacant by using 100 as the percentage amount and subtracting the vacancy ratio from 100 percent.

3.2.2 Mapping Dataset

US Census track boundary with socio-economic data for the City of Atlanta is chosen as the basis for all maps. The geographic coordinates of GAEPD brownfields (n=126) and child molesters (n=134) were determined by the geocoding function used in ArcMap. Geocoding was conducted using 10.0 North American Geocode Service (ArcGIS Online) was the address locator. Any unsuccessful initial matches were researched using Google online maps to obtain the correct address needed to have a high rate of geocoding. The shapefile of the point locations of fire stations, police stations, libraries, hospitals, and emergency rooms held the exact location of each point; therefore did not require any geocoding. The point locations of GAEPD Brownfields and child molesters were geocoded.

In summary, the point locations include libraries, police stations, fire stations, hospitals, emergency rooms, GAEPD brownfields and child molesters. The service area polygons were made around the community asset points of police stations, fire stations, libraries, hospitals, and emergency rooms. .In order to keep the newly selected variables in a positive alignment, vacancy was altered to “not vacant” to remain consistent with other variables.

Dispersion patterns of the point locations were tested using the Nearest Neighbor Analysis method, which entails a z-score that is relevant to this analysis because the point pattern analysis shows any spatial correlation between the points. Using 0.05 as the significance level, a one tailed independent t test is done utilizing a critical value of 1.645. Second spatial analysis software, PPA, is utilized to obtain a second measure of point dispersion for comparative purposes. When reviewing and presenting results, Fire stations are offered first, then Police stations, and third are Libraries. After that, Hospitals, fourth, and Emergency rooms, fifth, are given. Then ending the points are GAEPD brownfields and child molesters.

3.2.3 Network Analyst

The Network Analyst tool in ArcMap was used to the create service area polygons around police stations, fire stations, libraries, hospitals and emergency rooms in order to create a manner in which to measure health disparities in community asset coverage and to be considered alongside the UHIv7. Traditional buffers encompass an exact radius centered on the point location; it does not take into consideration several variables that Network Analyst will, such as transportation access, i.e. roads, the posted speed limits, or any other physical boundaries that would impede motion in that direction. This was done in order to compare the newly generated service area to the original census tract area. The ratio between the new and original polygons should show any disparity in coverage. The determined travel time and distance was five minutes'(chosen based upon fire fighters mobile response time from station to scene of incident) drive time by automobile at posted speed limits; the road dataset contains road segments and each segment has a speed limit. Before the service areas can be made, a network dataset has to be built, which is done in ArcMap. The road shapefile includes specific variables of time and distance. New fields were added to the road shapefile that included minutes and miles that utilizes posted miles/hour to determine service areas. The road dataset was measured in meters and miles/hour; the data was converted to meters/minute by adding new Fields using standard conversion methods. After the service areas are complete, then maps were generated that allowed for visual and statistical interpretation of the ratio between the original and new polygons. Figure 5 shows the steps followed to create Network Analyst Service Area polygons, along with polygon area ratio steps used in GIS software.

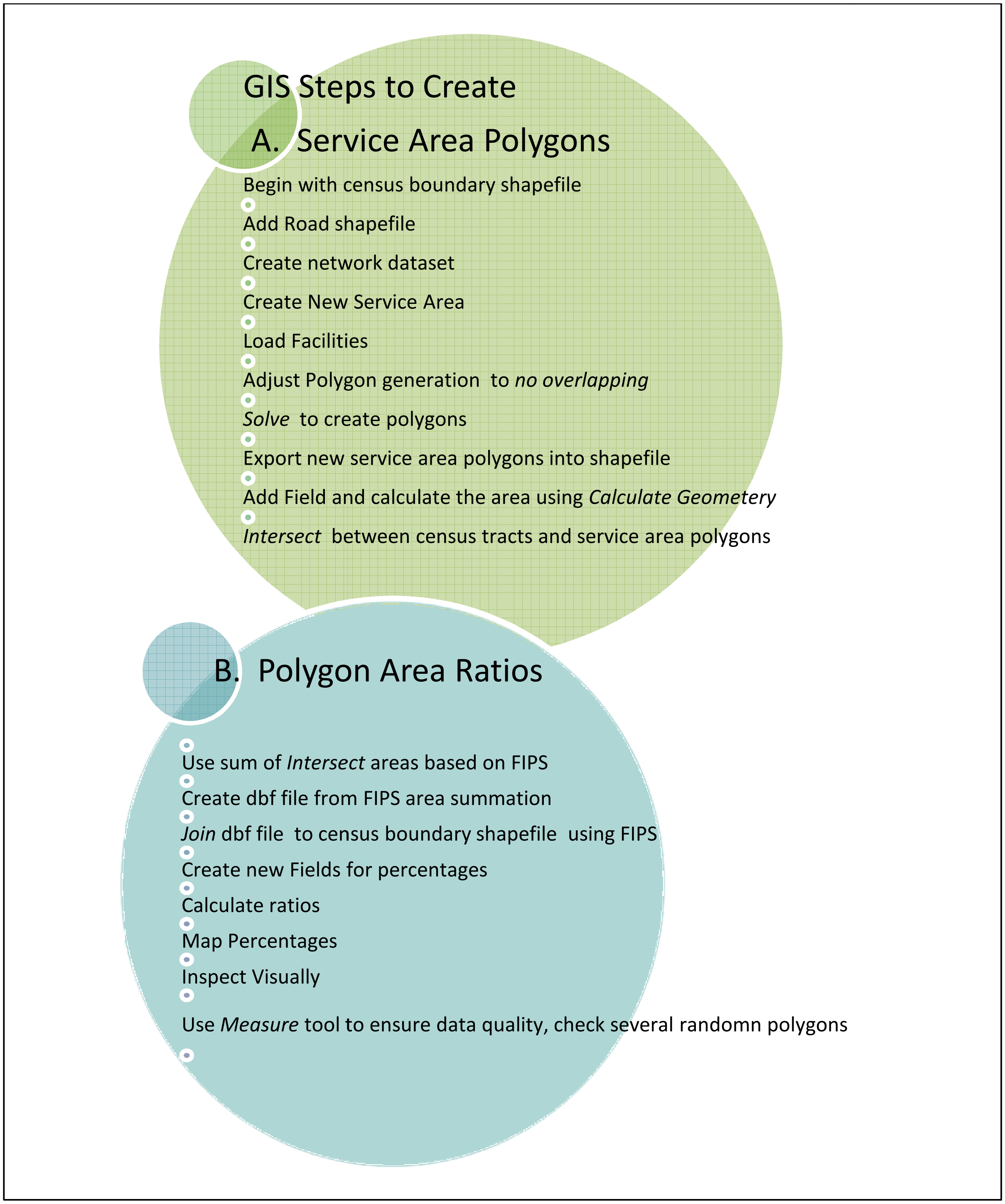

Figure 5 GIS Network Analyst Steps to get Polygon Area Ratios

The six indicator variables used to reach a geometric mean in this study are fire, police, libraries, hospitals, emergency rooms, and per not vacant. Percentage of not vacant does not require service area polygons.

3.2.4 Map Design

Map design was two-fold due to the dataset including both point and polygon locations. ArcMap 10.0 was the GIS software used to produce all maps. The Projected Coordinate System used for all maps was NAD 1983 UTM Zone 16N with a Geographic Coordinate System of GCS North American 1983, the same as UHIv7. The maps will be the same ramp used by the Urban Health Index mappers, red hues; the reason for this for comparative purposes with a flipped color ramp. Normal cartographic methods will be implored to add legend, title, text boxes, and a scale bar, and if applicable point locations used an easily recognizable symbol to represent the location.

3.2.5 UHIv7 Methodology

The statistical methods of UHIv7 were implored directly from the two studies by Rothenberg et al. (2011 and 2012). First, the observed values of the six chosen indicators were standardized by the following equation using the correction for minimum values (Rothenberg et al 2012):

$$I^S = \frac{I - \min^*(I)}{\max(I) - \min^*(I)}.$$

In this formula, *I* is the actual observed value and *min** refers to the lowest observed value, which can be zero, but due to mathematical properties of division, a zero cannot be in the numerator. Therefore, the “min” has been slightly adjusted and named min* to denote the difference, see Table 2 for the variance between the two. The “max” is the maximum observed value.

Table 2 Min & Max Values for Variable Standardization

	Min	Min*	Max
Library	0.03438	0.03436	100
Fire Stations	4.2608	4.26078	100
Police Stations	0	-0.00002	100
Hospitals	0	-0.00002	100
Emergency Rooms	0	-0.00002	100
Vacancy	55.6664	55.66638	92.7239

After the variables are standardized, the geometric means were calculated. Each standardized variable is first multiplied to determine the product then raised to the (1/n). The equation is as follows (Rothenberg et al 2012):

$$G = \left(\prod_{i=1}^{n} I_i^S \right)^{\frac{1}{n}}.$$

Once the final single numeric value is reached for each census tract, it is mapped following the UHIv7's example of lighter hues to denote the higher range of the variables because all of the variables indicate positive attributes. The maps are then directly compared visually. Then five individual census tracts were selected due to the variance between the three different UHIs or their similarities. Street and Ariel maps were made to obtain a better understanding of the census tract using both Google Earth and ArcMap basemaps. Then, a map was made that contained each of the community asset and liability variables for final thoughts.

4 RESULTS

4.1 Results

4.1.1 Census Data

The US census data showed the population of the City of Atlanta for the year 2010 to have the ethnic breakdown (Figure 5) with the majority belonging to African-American, 54% with Whites following with 36% of the total population. The next Figures, 6and 7, shows the spatial distribution of the top two ethnicities. The extremes of both groups can be seen though mapping. Vacancy rates were also mapped to view the spatial variation of the variable, Figure 8.

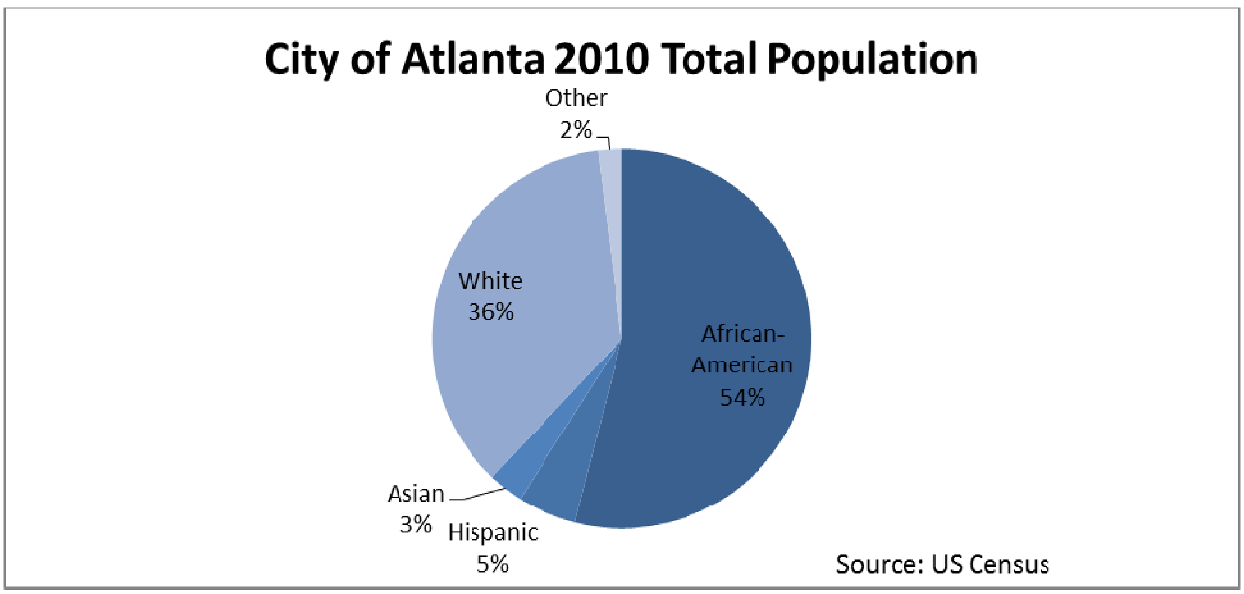

Figure 6 City of Atlanta 2010 Population

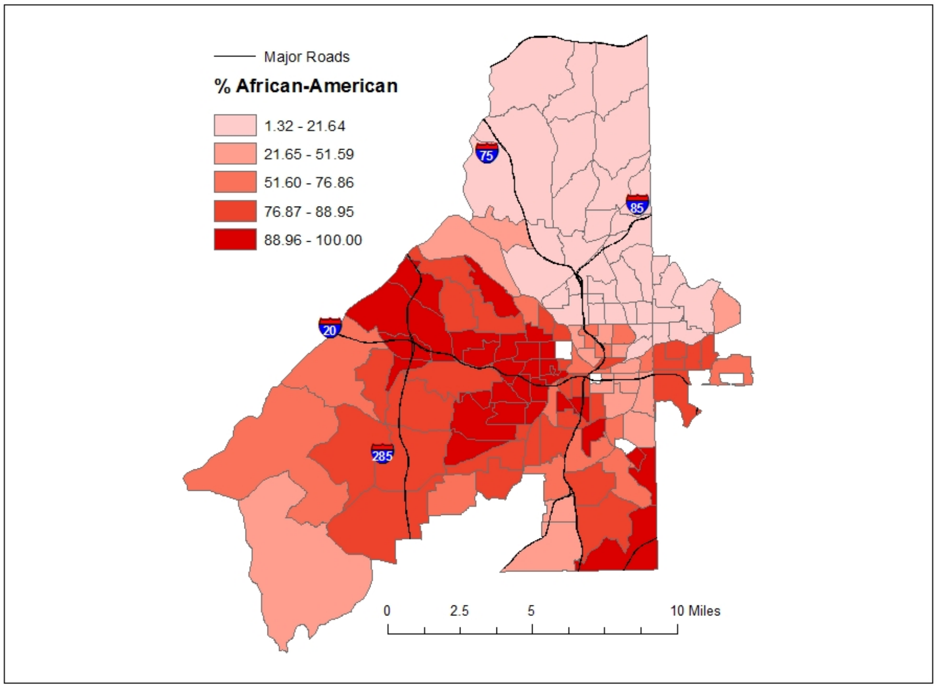

Figure 7 African-American Population Distribution

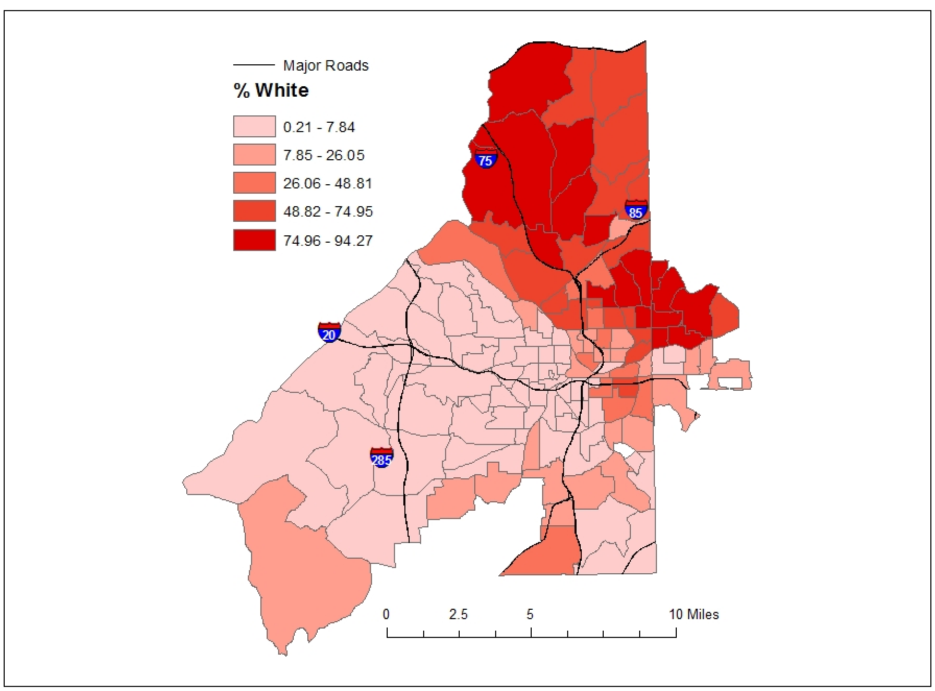

Figure 8 White Population Distribution

The vacancy map also shows a concentration of high rates of vacancies in the center of the city. Vacant properties can be a haven for unwanted criminal activities (Baumer et al 2012). When compared to the UHIv7, the vacancy map also shows a concentration of high rates of vacancies in the center of the city; this information supports the UHI findings, with a lesser Quality of Life for these citizens.

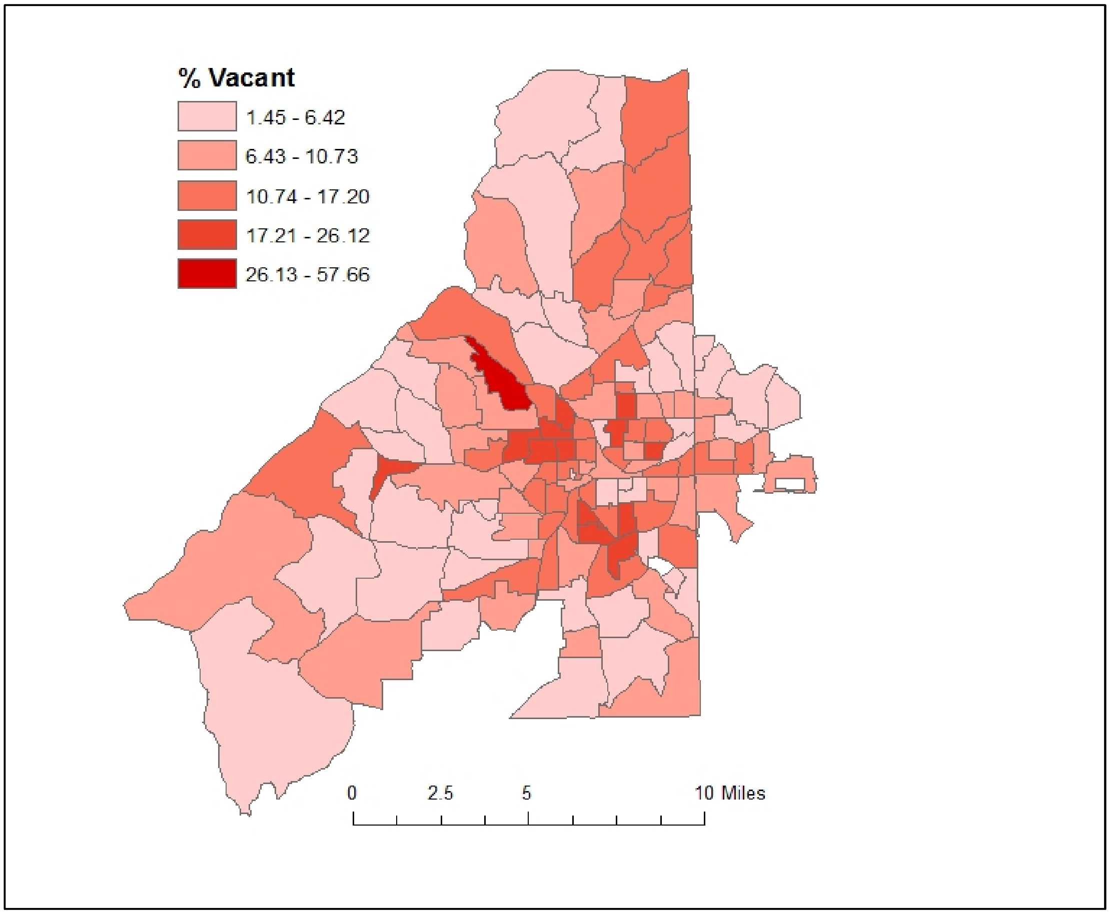

Figure 9 Percentage Vacant Distribution

A histogram of the percentage of not vacant properties is shown in Figure 9. The histogram shows the data to be slightly skewed to the right but mainly a normal distribution.

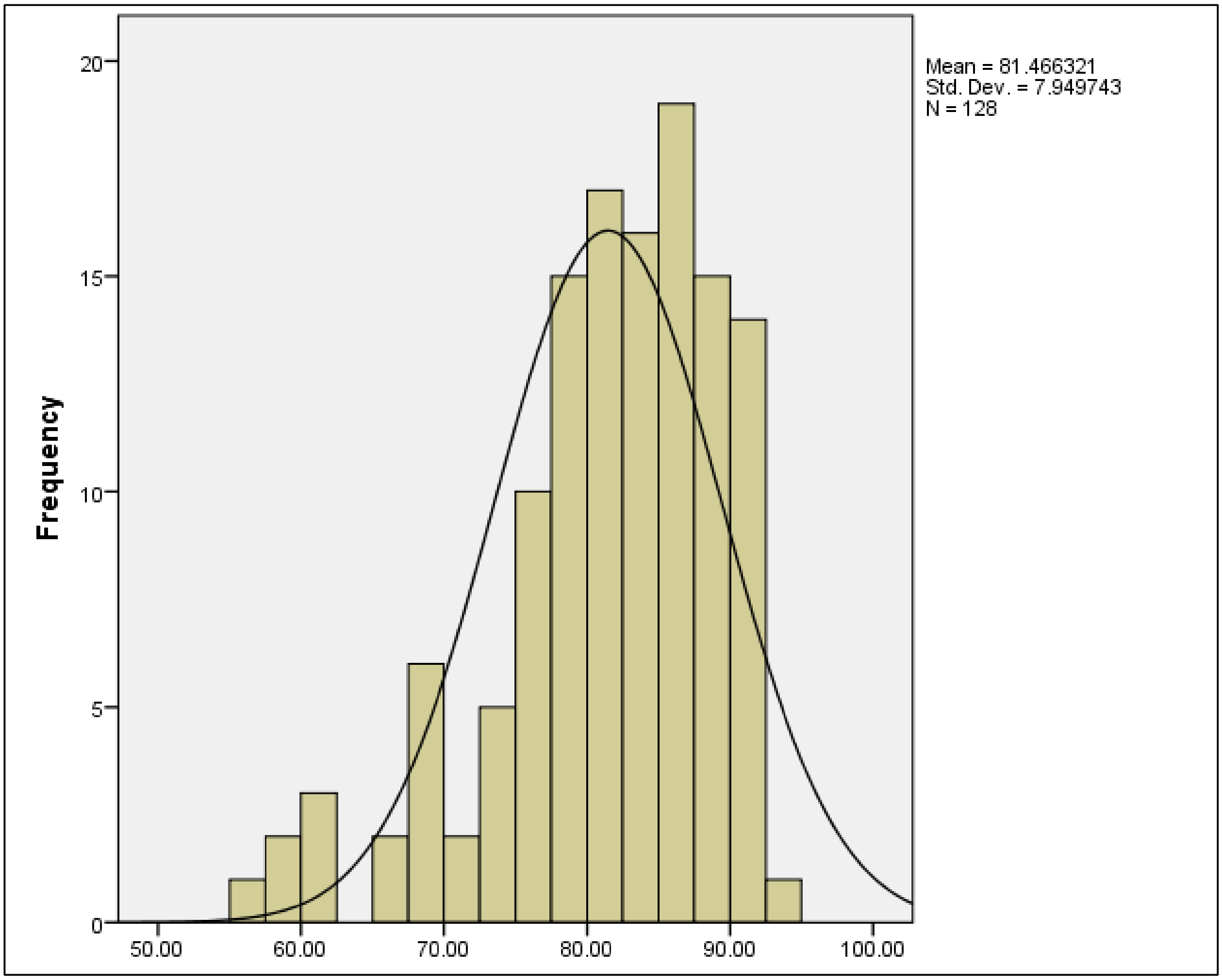

Figure 10 Histogram of Distribution of Not Vacant Properties

4.1.2 Geocoding

The brownfield locations had a very high rate of geocoding success, 99%; this is due to the use of this dataset in the author's previous research project. Child Molesters were geocoded at a high rate of success, 96%, because of the limited number of offenders, during data preparation all addresses were reviewed to ensure the correct addresses.

4.1.3 Point Pattern Analysis

Fire stations are offered first, (Figure 10). The fire stations appear visually fairly evenly distributed spatially throughout the entire city; suggesting a high coverage for all citizens. A small lapse in coverage can be seen south of I-20 and east of I-285. Point Pattern analysis yielded a z-score of 1.7057 from ArcMap, (Figure 11), which is higher than the critical value of 1.645. This suggests that the fire station locations are not clustered but dispersed. A lack of clustering is desired because it implies that either a random or dispersed distribution is present, which equates to a measure of accessibility.

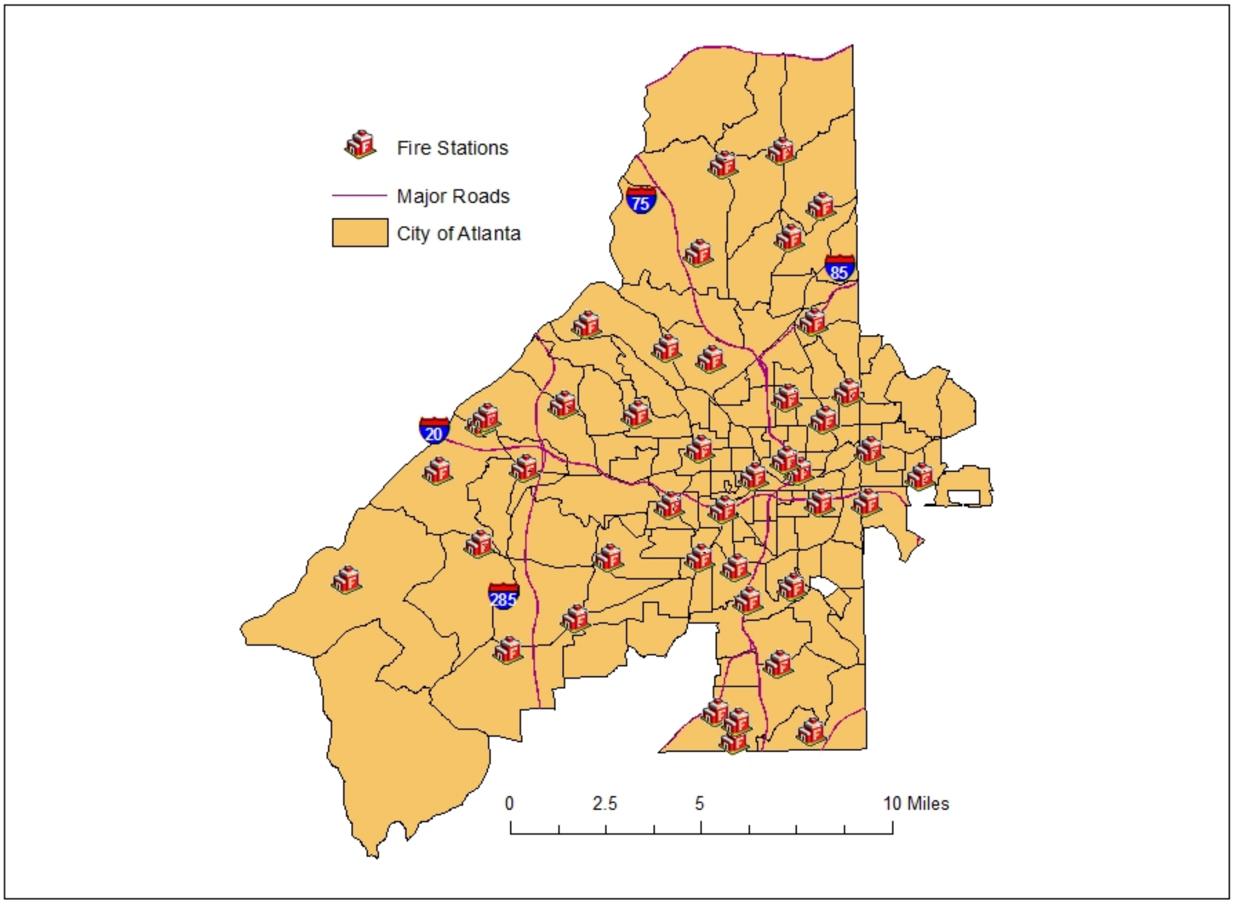

Figure 11 Fire Stations

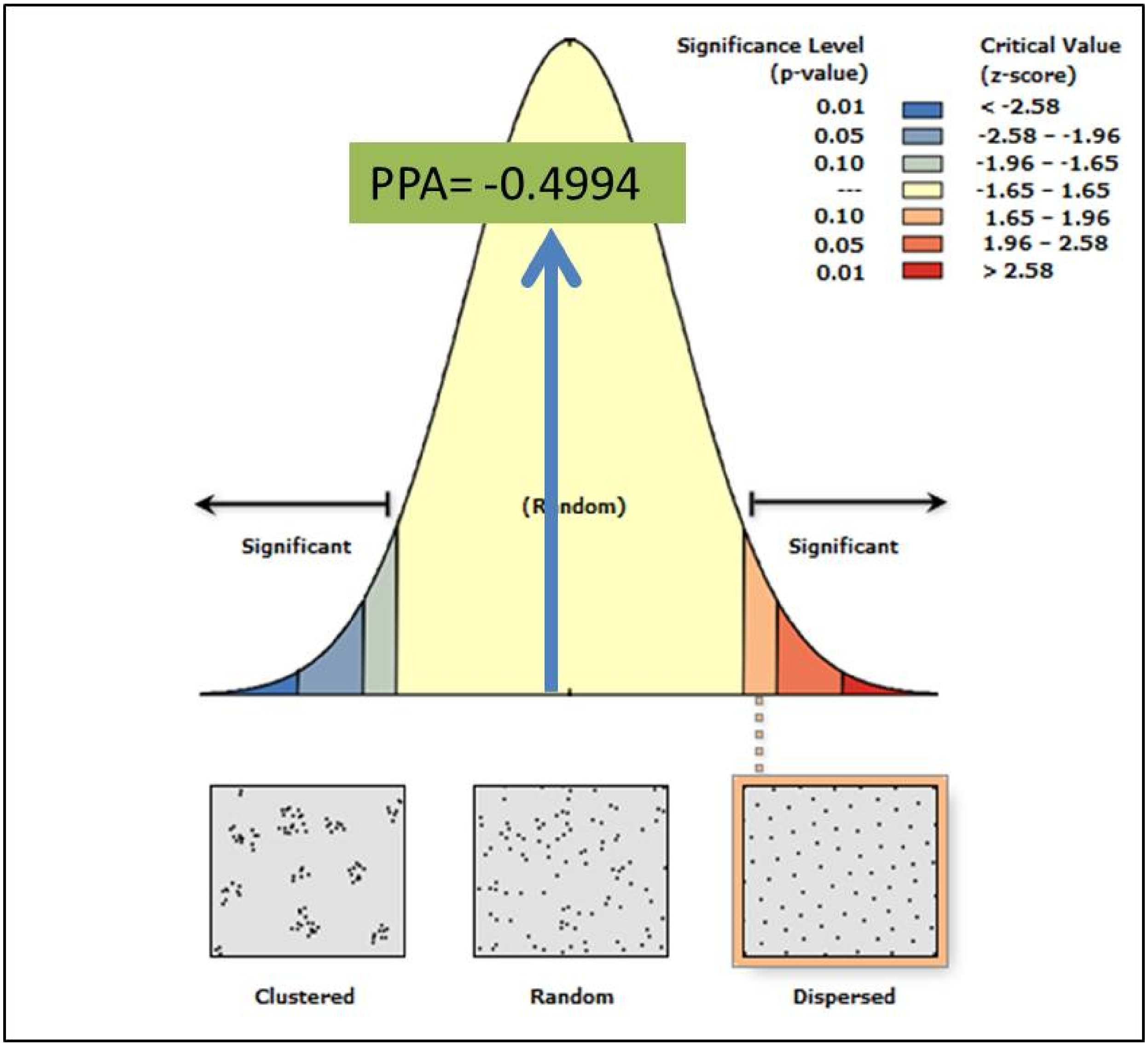

Figure 12 NNA Fire stations

Figure 12 shows police stations. Upon initial review, the amount of police stations, n= 26, is far less than the number of fire stations, n= 45. More police stations are located in the center and south of the city and with little to no coverage in the northern portion of Atlanta. The z-score 1.8323 suggests point dispersion, (Figure 13), but PPA offers a different result, -0.3656, that states the locations are random.

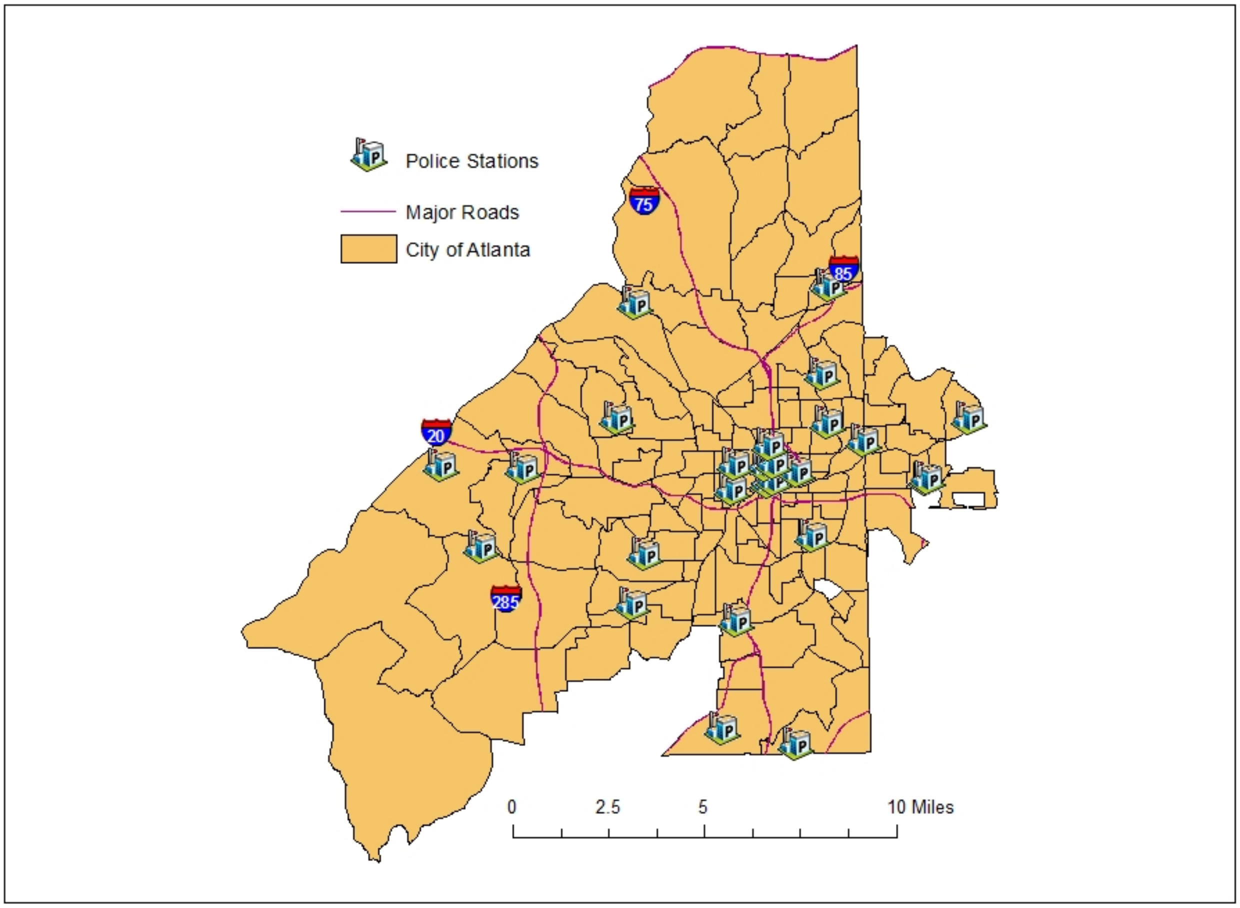

Figure 13 Police Stations

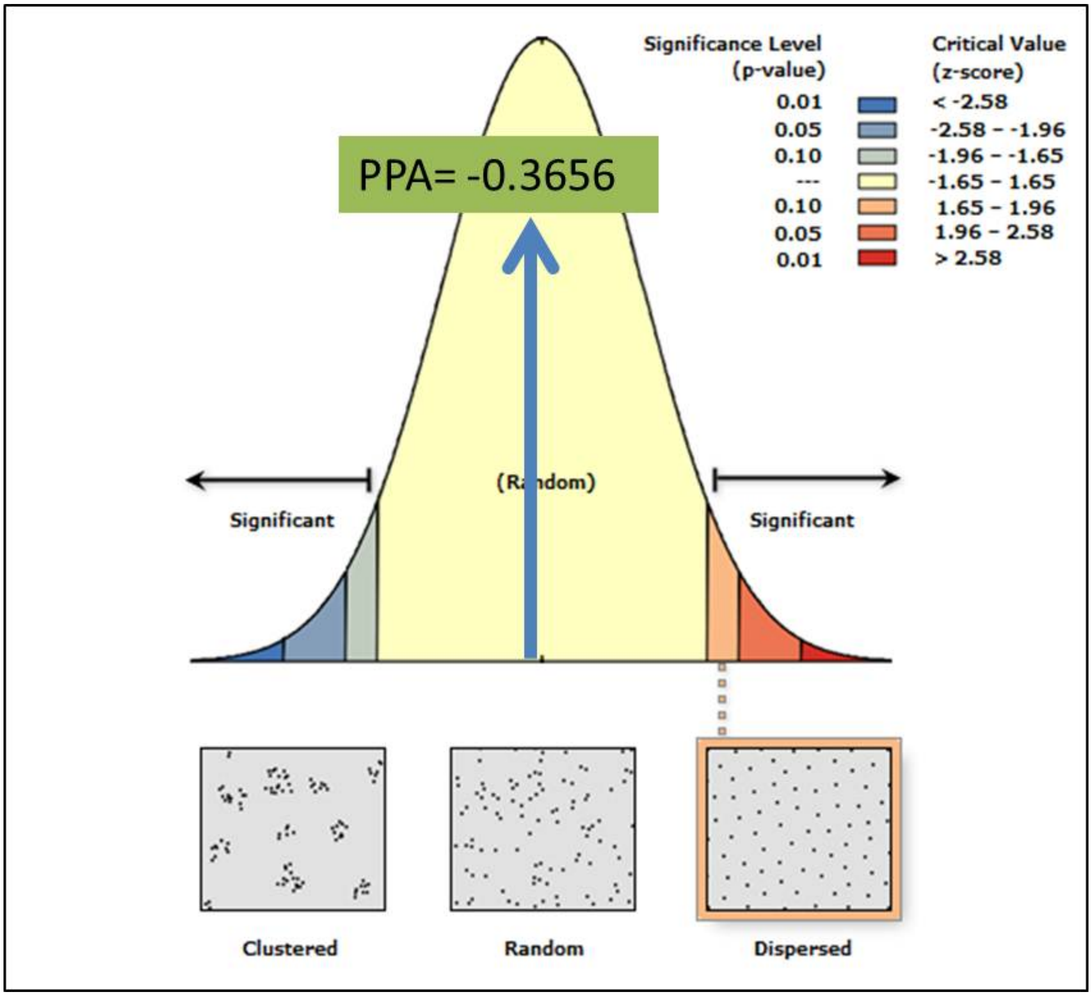

Figure 14 NNA for Police Points

Regarding libraries, the City of Atlanta has 26 libraries. The map (Figure 14) shows its concentration mainly in the center band of the city. The z-score for libraries is 4.2674, (Figure 15); these points are dispersed.

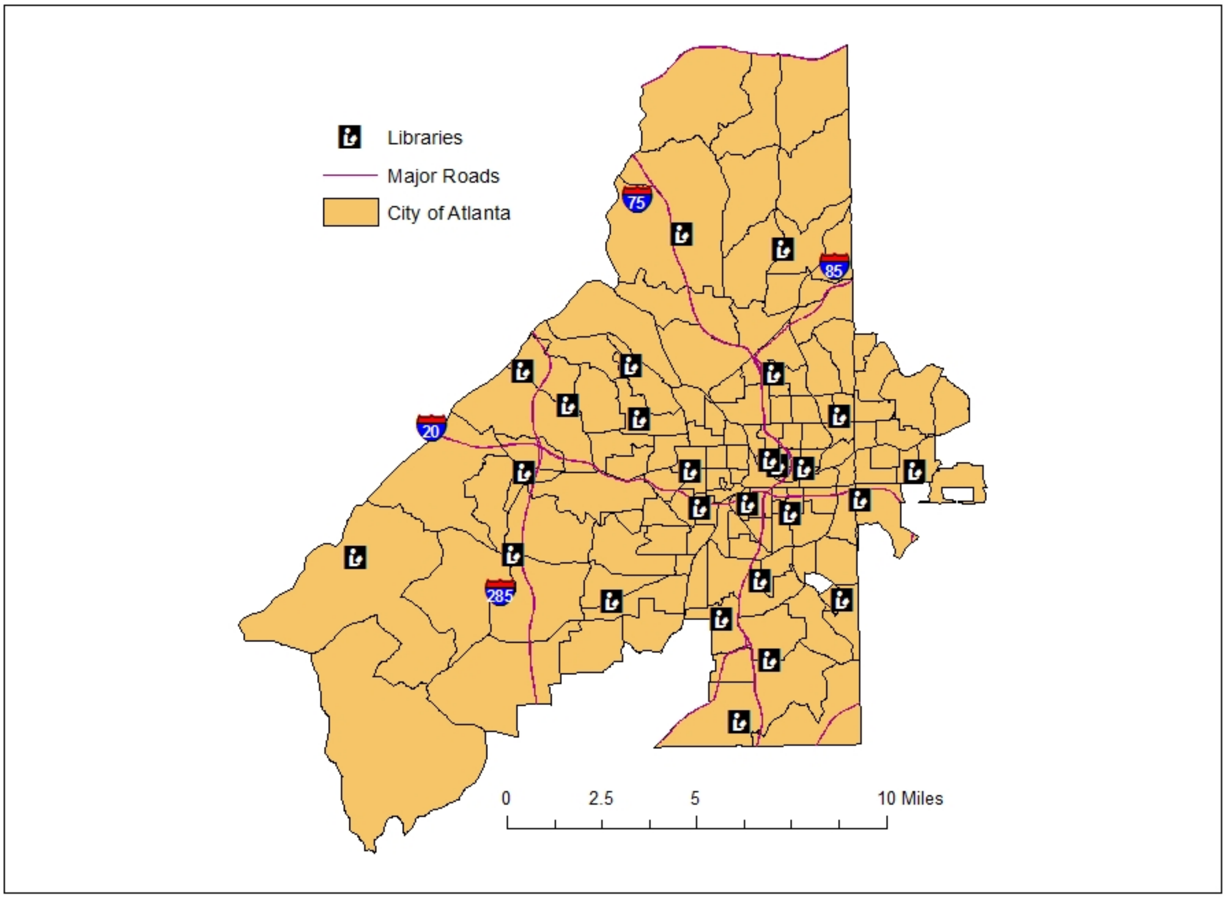

Figure 15 Libraries

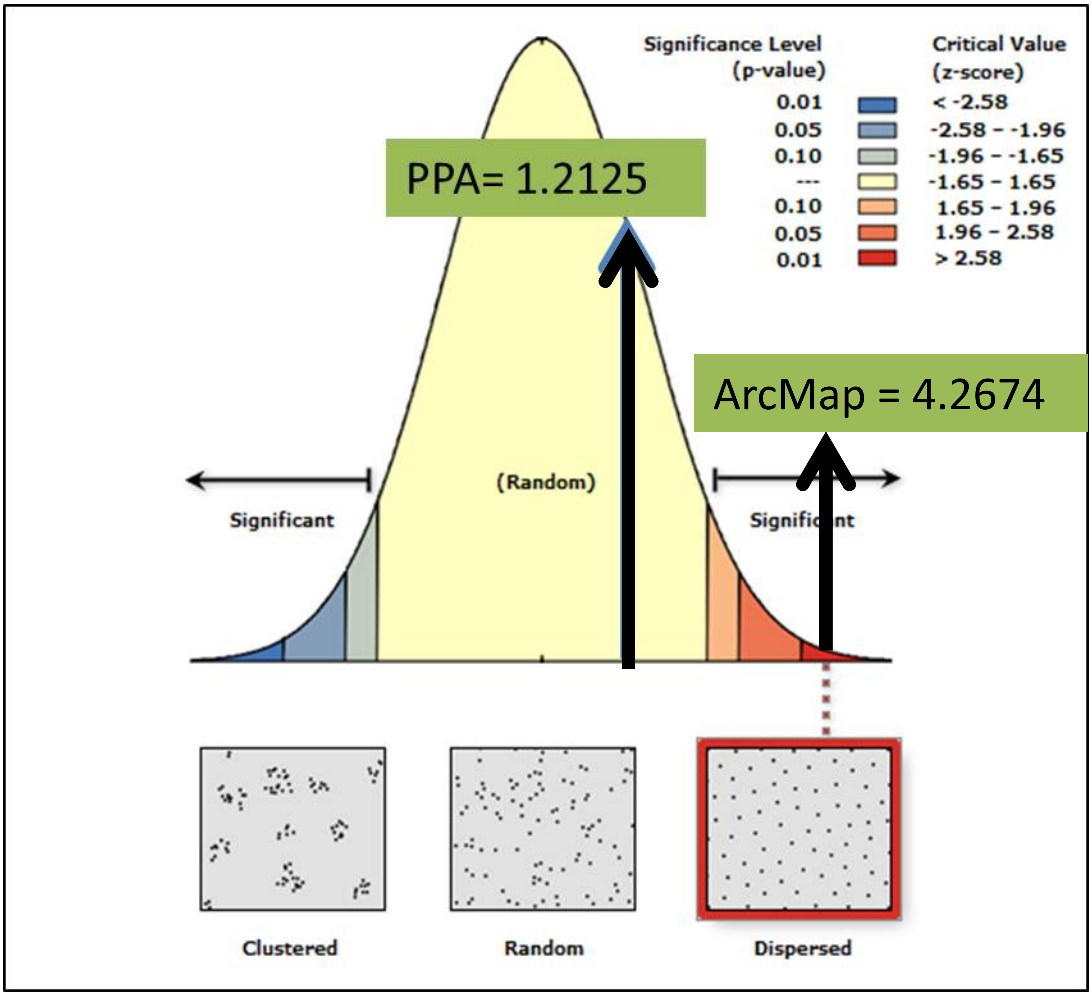

Figure 16 NNA for Libraries

Figure 16 displays the hospital point locations. Visual inspection shows that throughout the city, there is limited accessibility to the hospitals with the crux being found in the central downtown area. The z-score for hospitals were determined to be -1.5291 and random, (Figure 17).

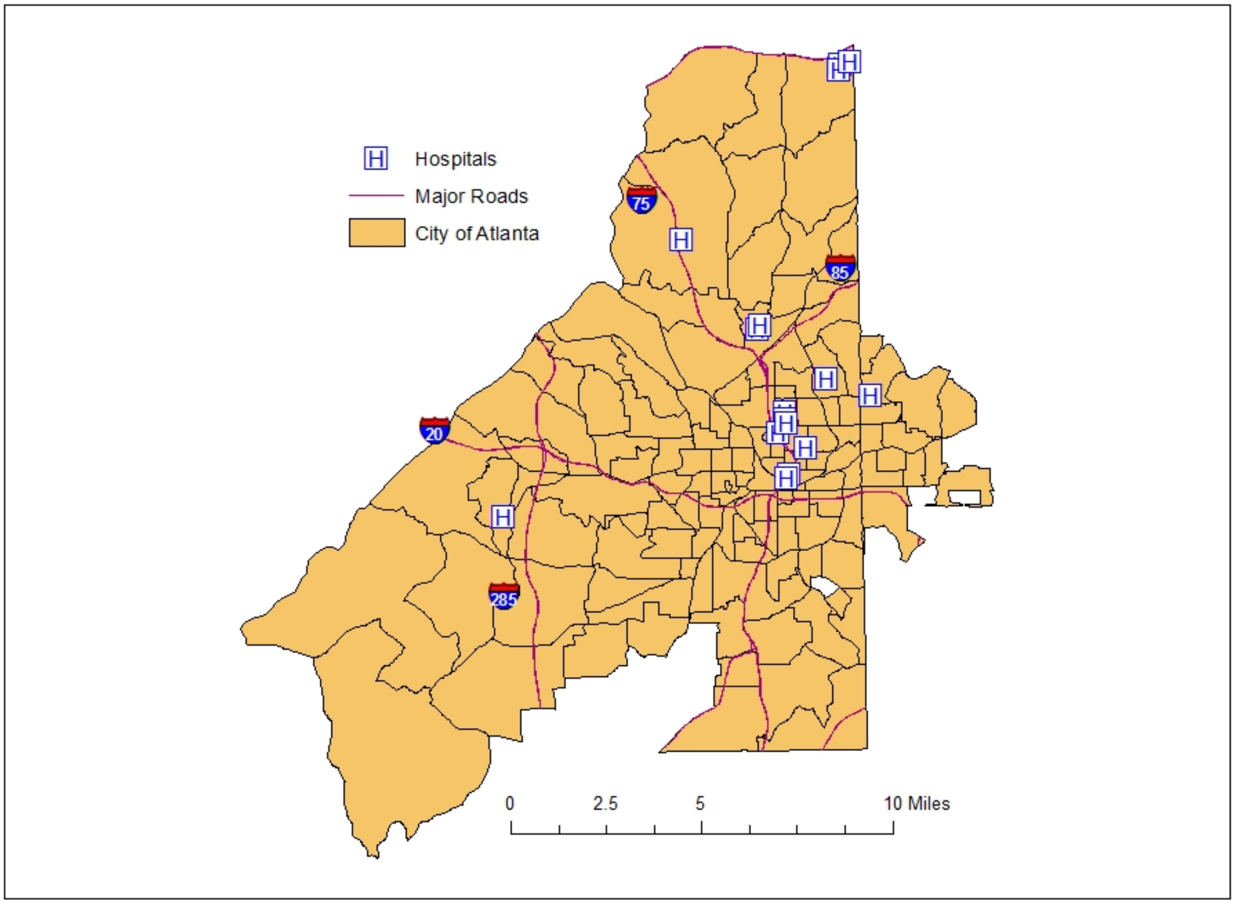

Figure 17 Hospitals

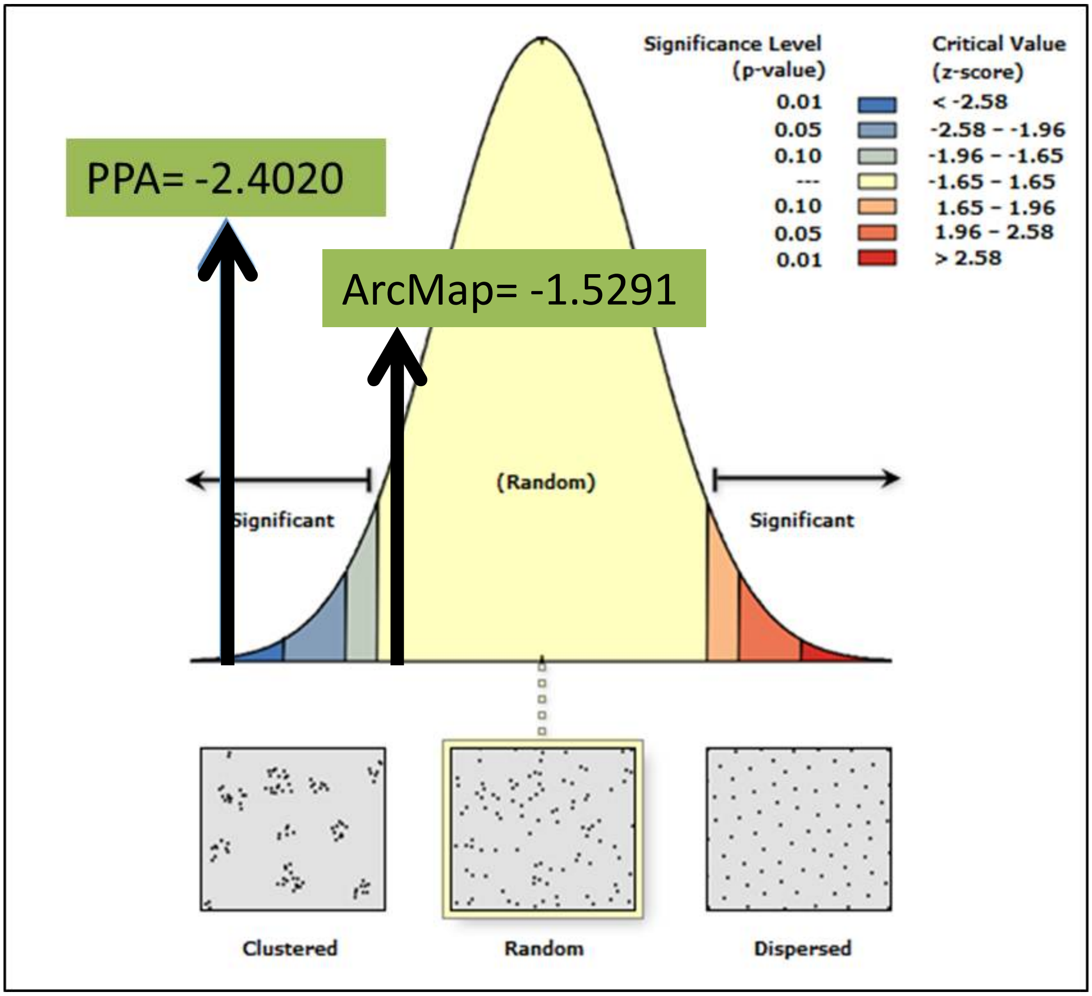

Figure 18 NNA Hospitals

Figure 18 displays Emergency Rooms which are very similar to the main entrance maps. The z-score for Emergency Rooms is 0.4298, (Figure 19). These points are random.

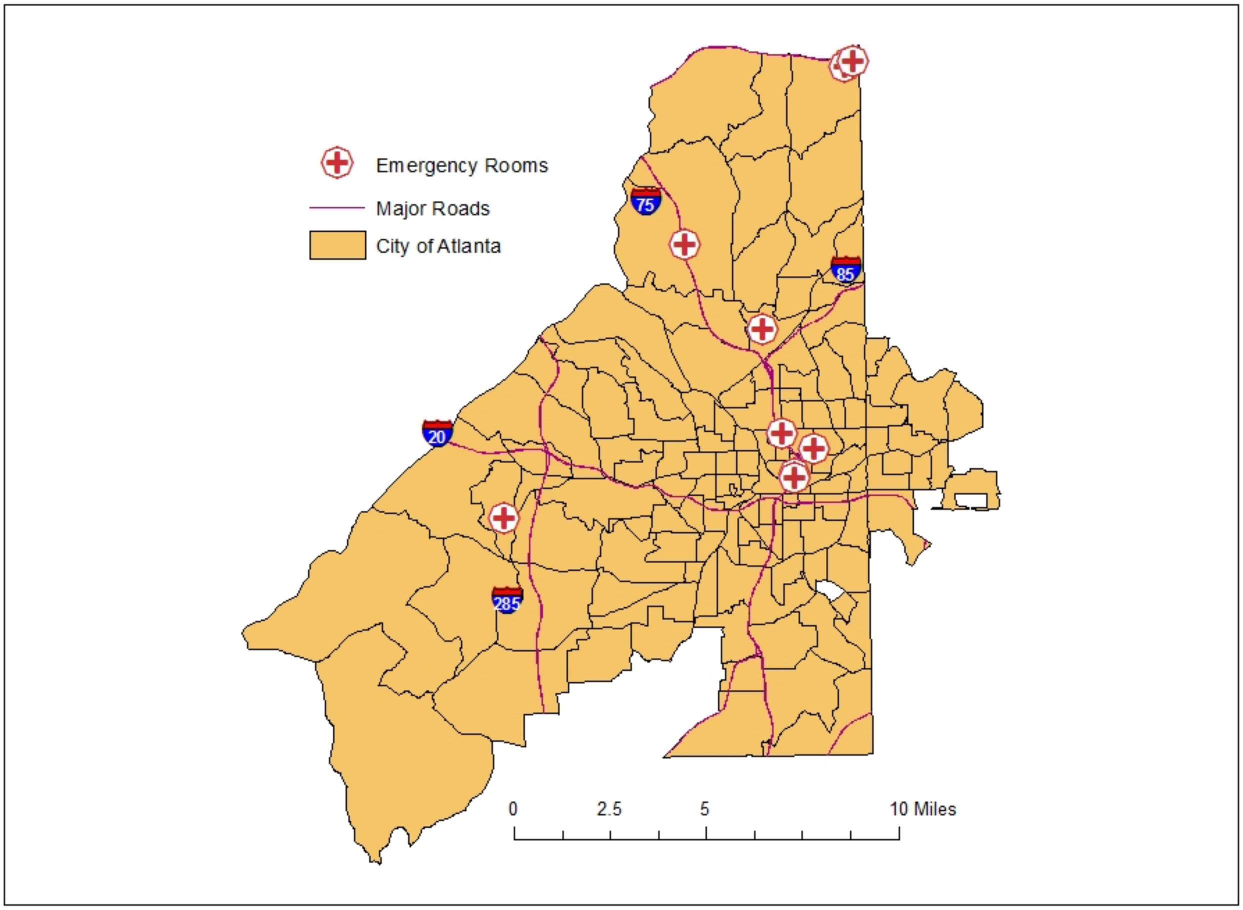

Figure 19 Emergency Rooms

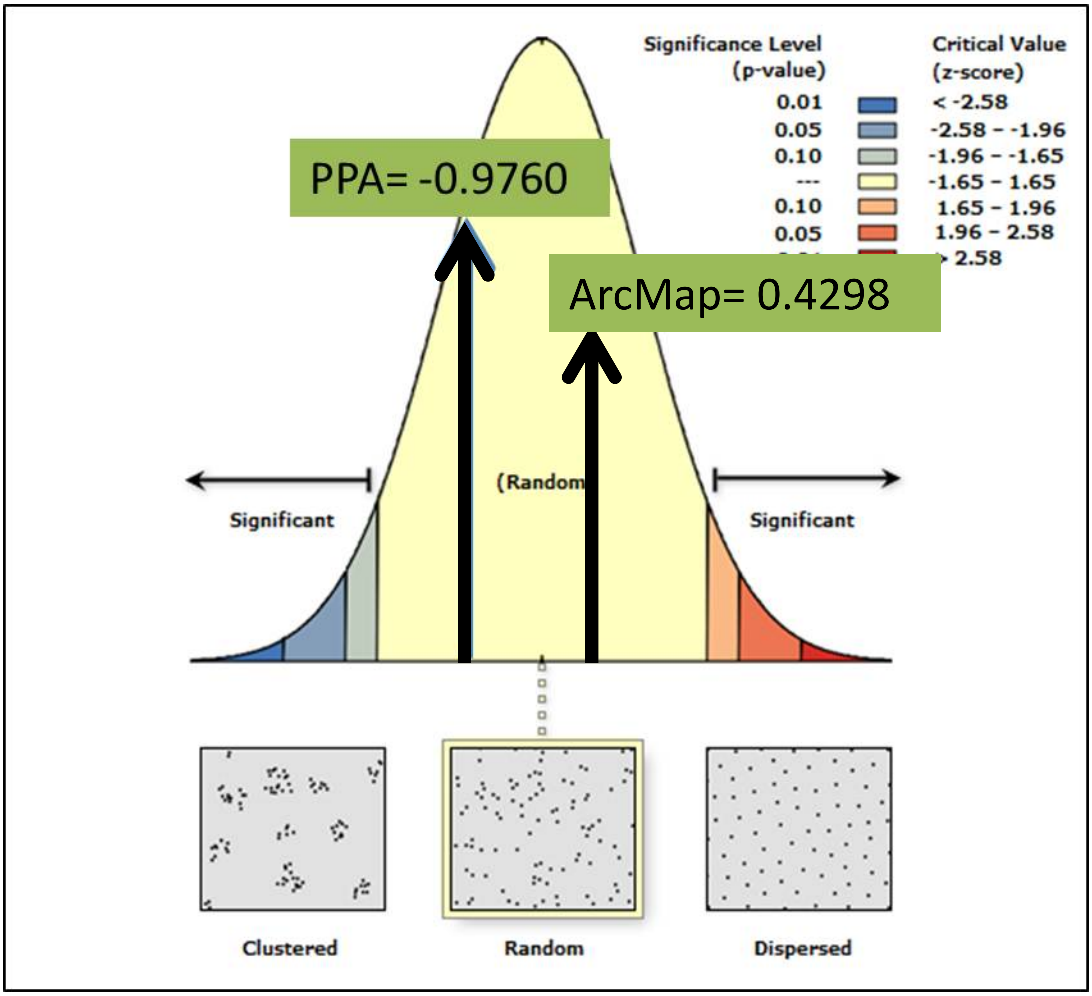

Figure 20 NNA Emergency Rooms

Brownfield locations are oriented around transportation routes, as seen with other maps. With initial review of the map, the GAEPD brownfields are located on the outer band from the downtown area heading north. The z-score was -10.2367; these points are highly clustered, (Figure 20).

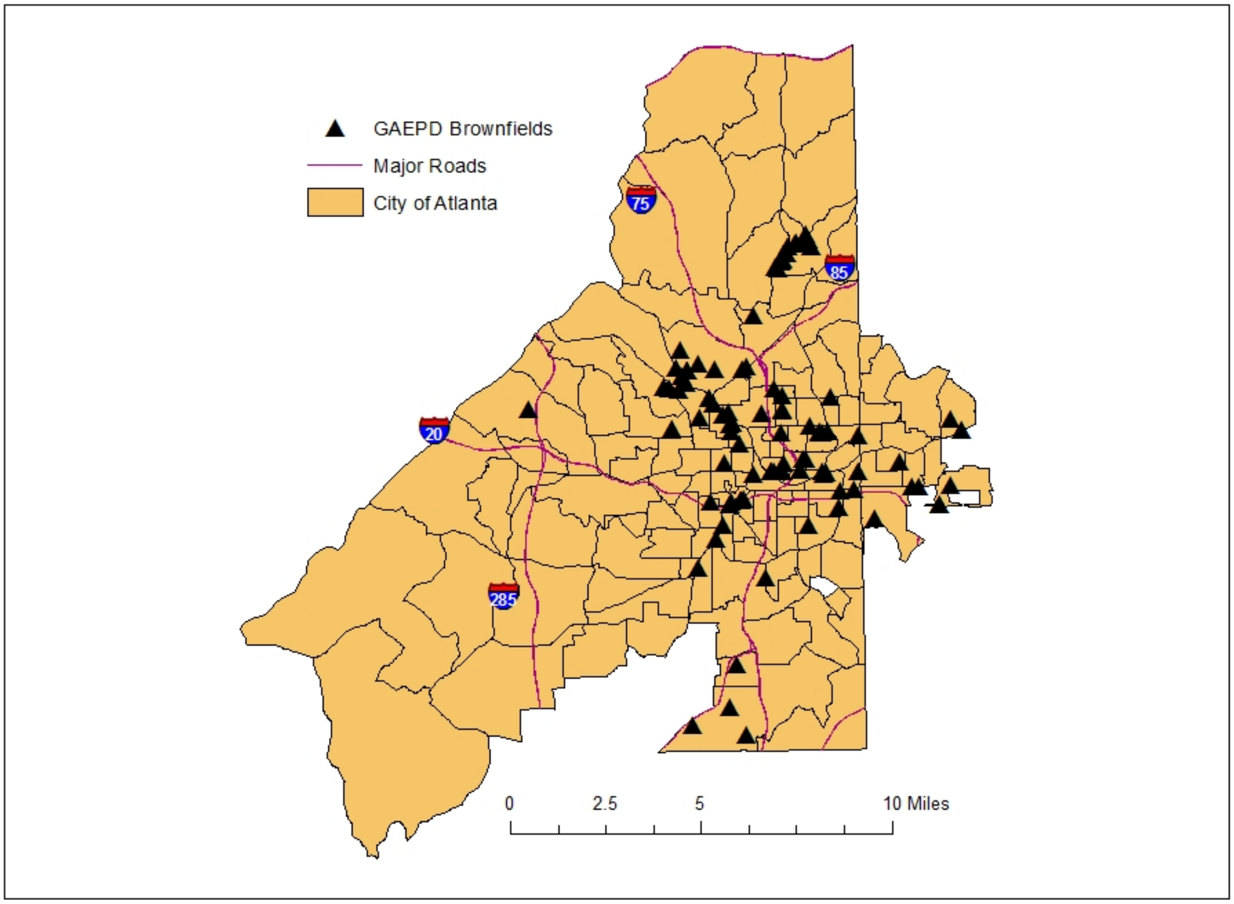

Figure 21 GAEPD Brownfields

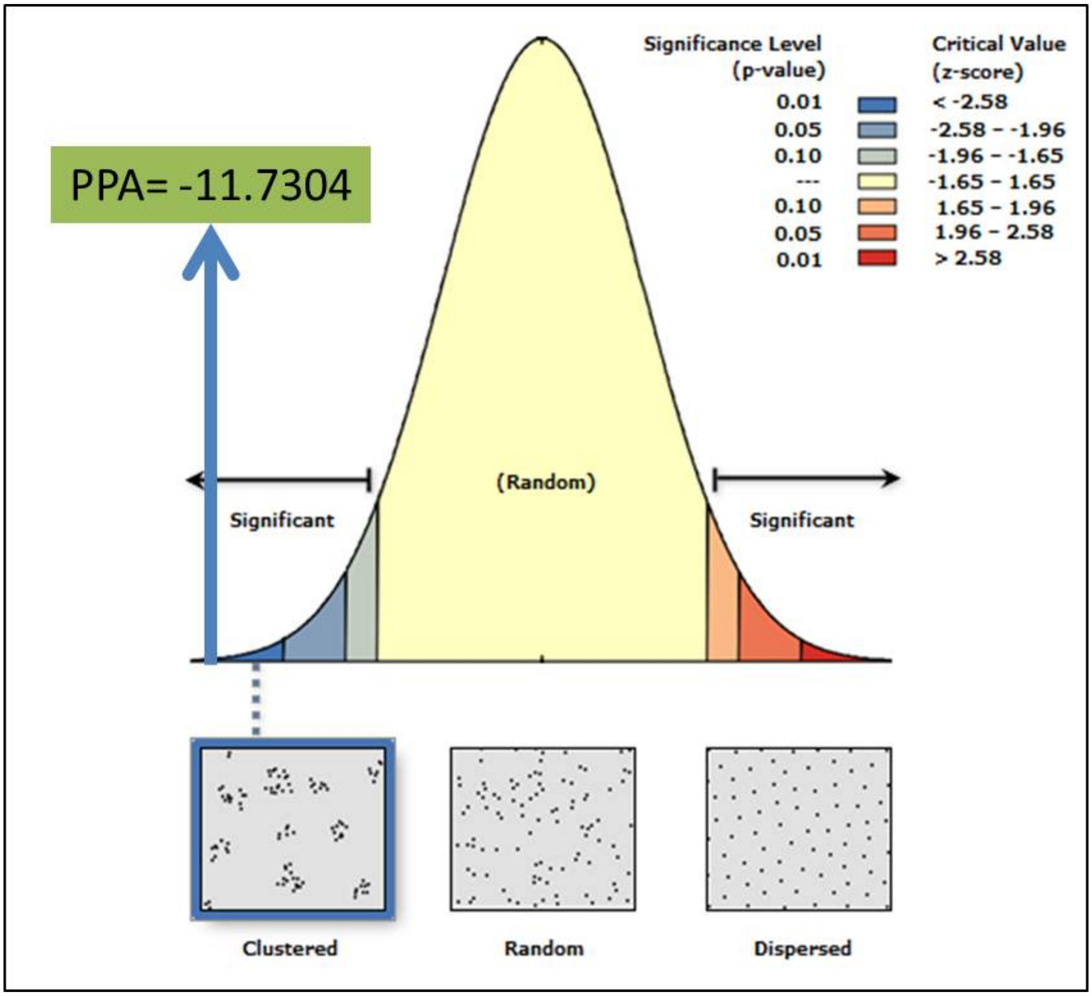

Figure 22 NNA GAEPD Brownfields

Child molesters are shown in Figure 22. A visual inspection shows clustering in the center and lower portions of the city. The z-score is -5.5547, (Figure 23).

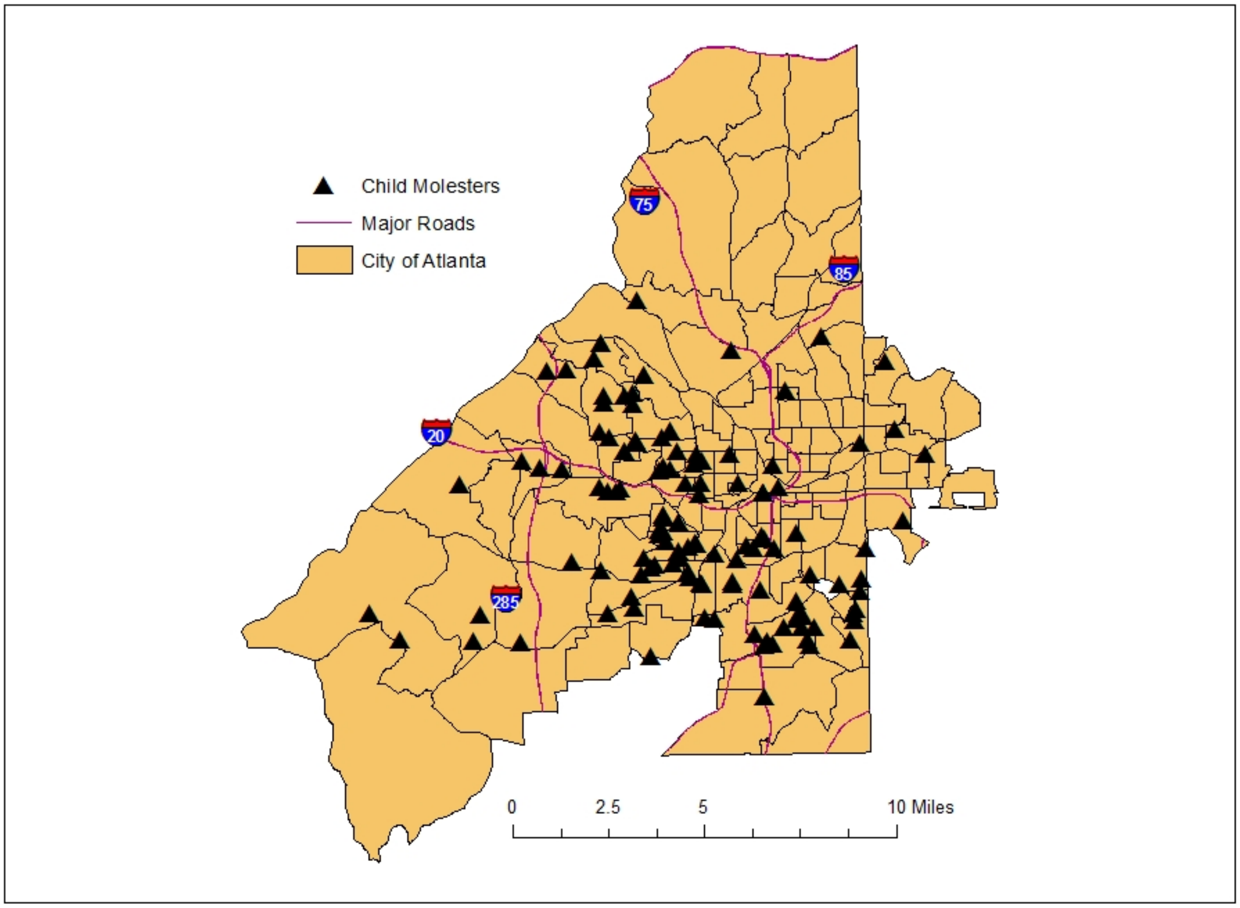

Figure 23 Child Molesters

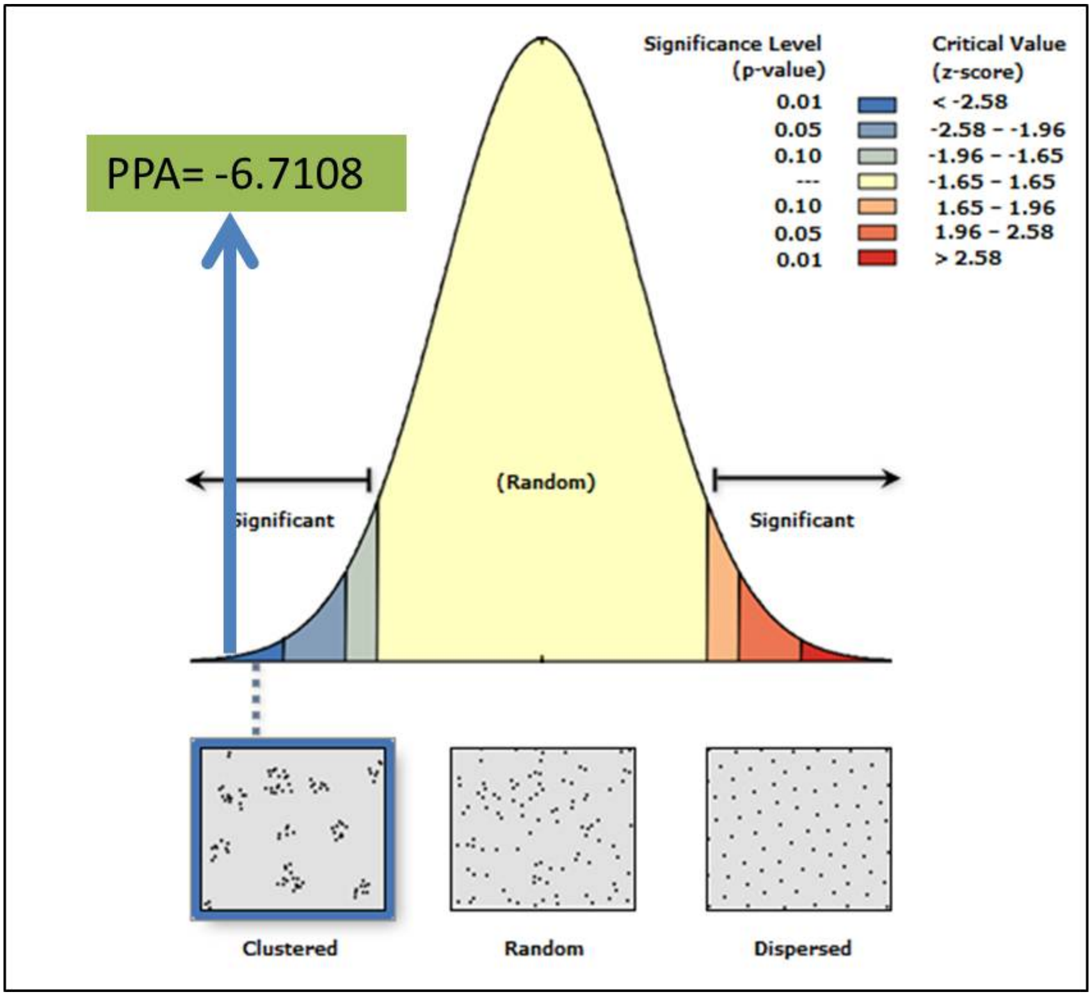

Figure 24 NNA Child Molesters

Table four shows has listed the ArcMap and PPA z-scores along with pattern type.

Table 3 Point Pattern Analysis Z-score comparison

	ArcMap Z-score	ArcMap Pattern Type	PPA Z-Score	PPA Pattern Type
Library	4.2674	Dispersed	1.2125	Random
Fire Stations	1.7057	Dispersed	-0.4994	Random
Police Stations	1.8323	Dispersed	-0.3656	Random
Hospitals	-1.5291	Random	-2.4020	Clustered

Emergency Rooms	0.4298	Random	-0.9760	Random
GAEPD Brownfields	-10.2367	Clustered	-11.7304	Clustered
Child Molesters	-5.5547	Clustered	-6.7108	Clustered

4.1.4 Network Analyst

The community asset point locations were used as the center for a five minute drive time highly detailed buffer generated from the ArcMap tool of Network Analyst. Compared to a traditional buffer with a fixed radius from the center point; Network Analyst takes into attention the roads, speed limits, and any other obstacle or restriction to movement.

The five minute service area of the fire stations covers large portions of the city with only one noticeable gap in the southwestern edge of the city. These service areas appear to protect and serve the majority of the City of Atlanta.

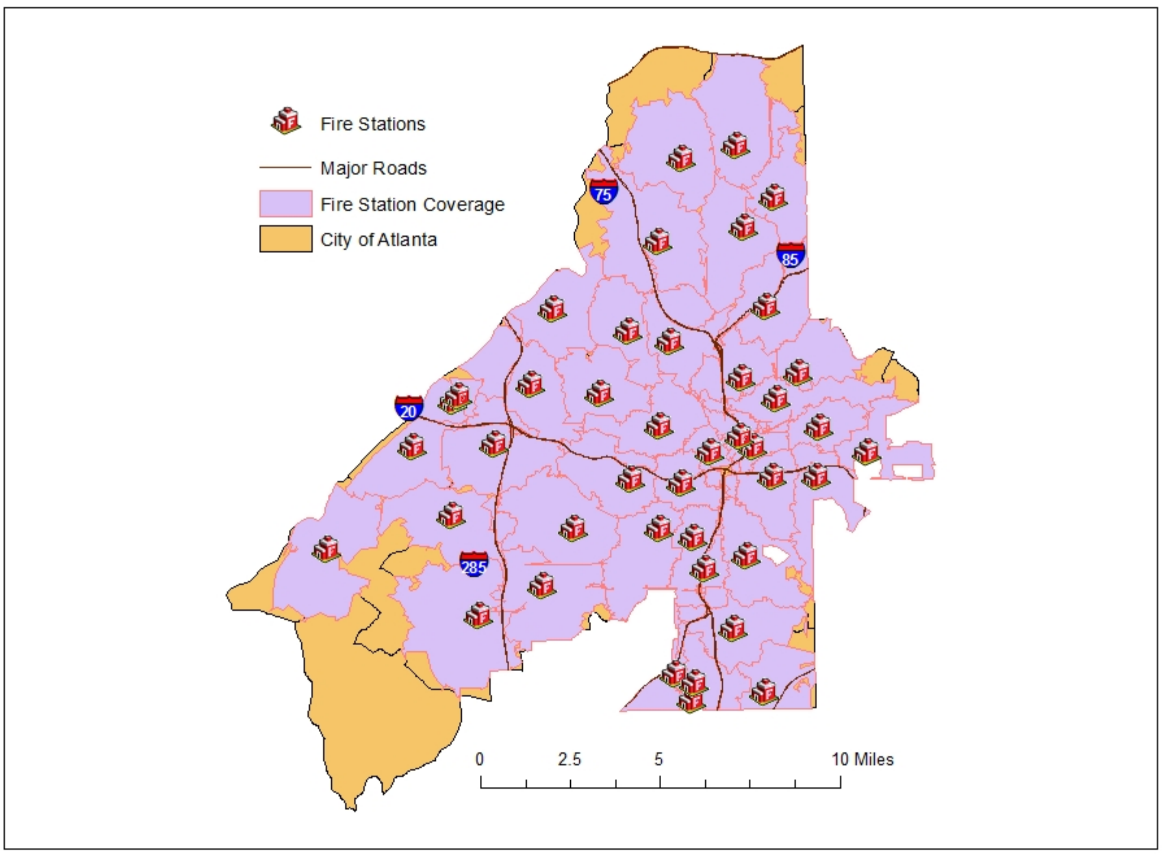

Figure 25 Fire Station Coverage Area Polygons

The histogram of the fire station coverage ratio, Figure 25, showing that the data is skewed positively which is beneficial to all city residents.

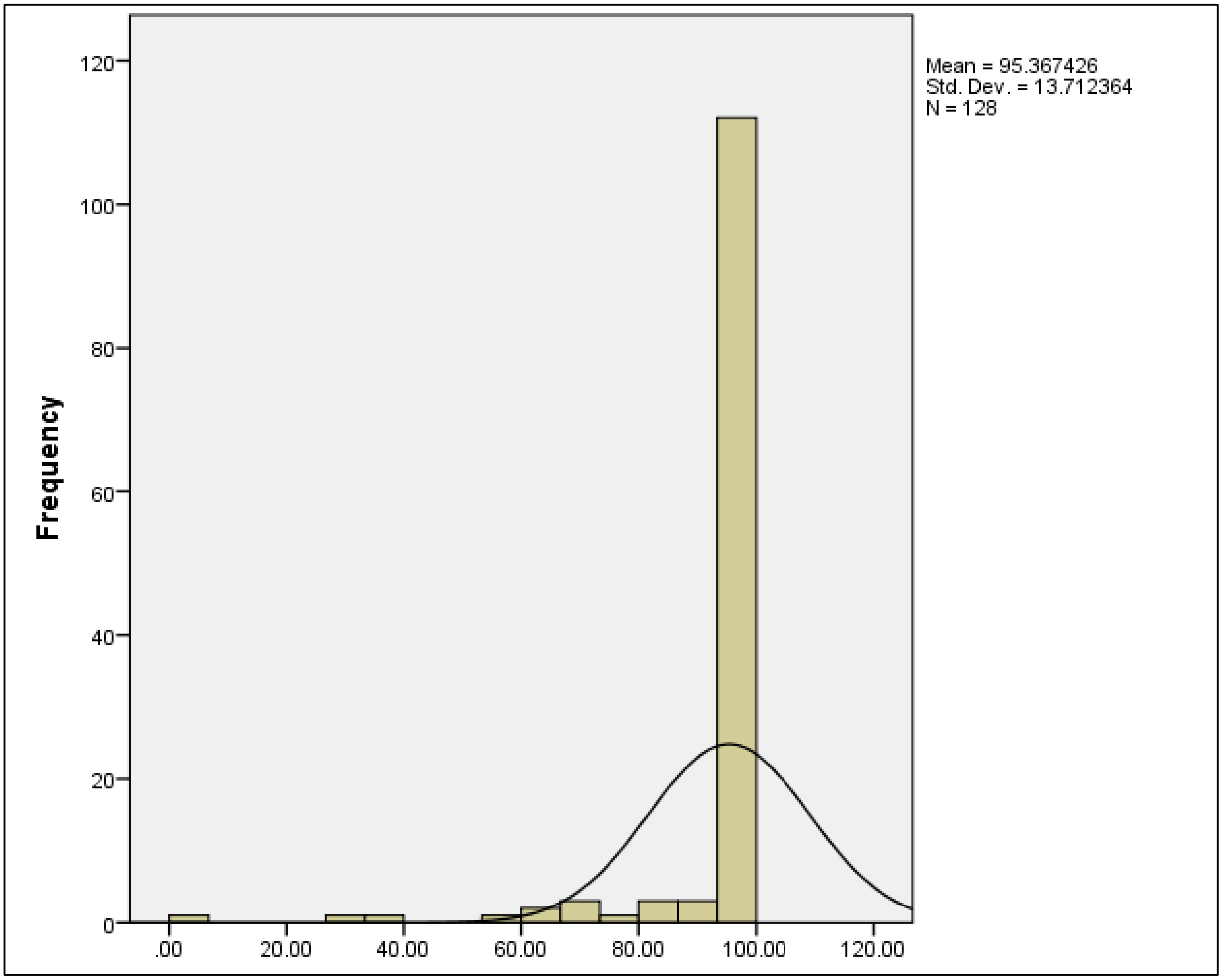

Figure 26 Histogram of Fire Station Coverage Area Ratio

Upon initial review of the Atlanta Police Department station locations, the maps show a cluster of police stations in the downtown area; this portion of the city is highly urbanized with many residents. The service area polygons for the police station locations show a fairly complete coverage for the extended central city. For the areas with police stations, the coverage area can be seen as extensive around each site with little to no gaps but overall far less than the fire station coverage. Comparing with the map of UHIv7, the downtown area was shown to provide the lower UHIv7 values. The histogram of police station coverage is similar to that of fire station coverage; it is skewed positively as well.

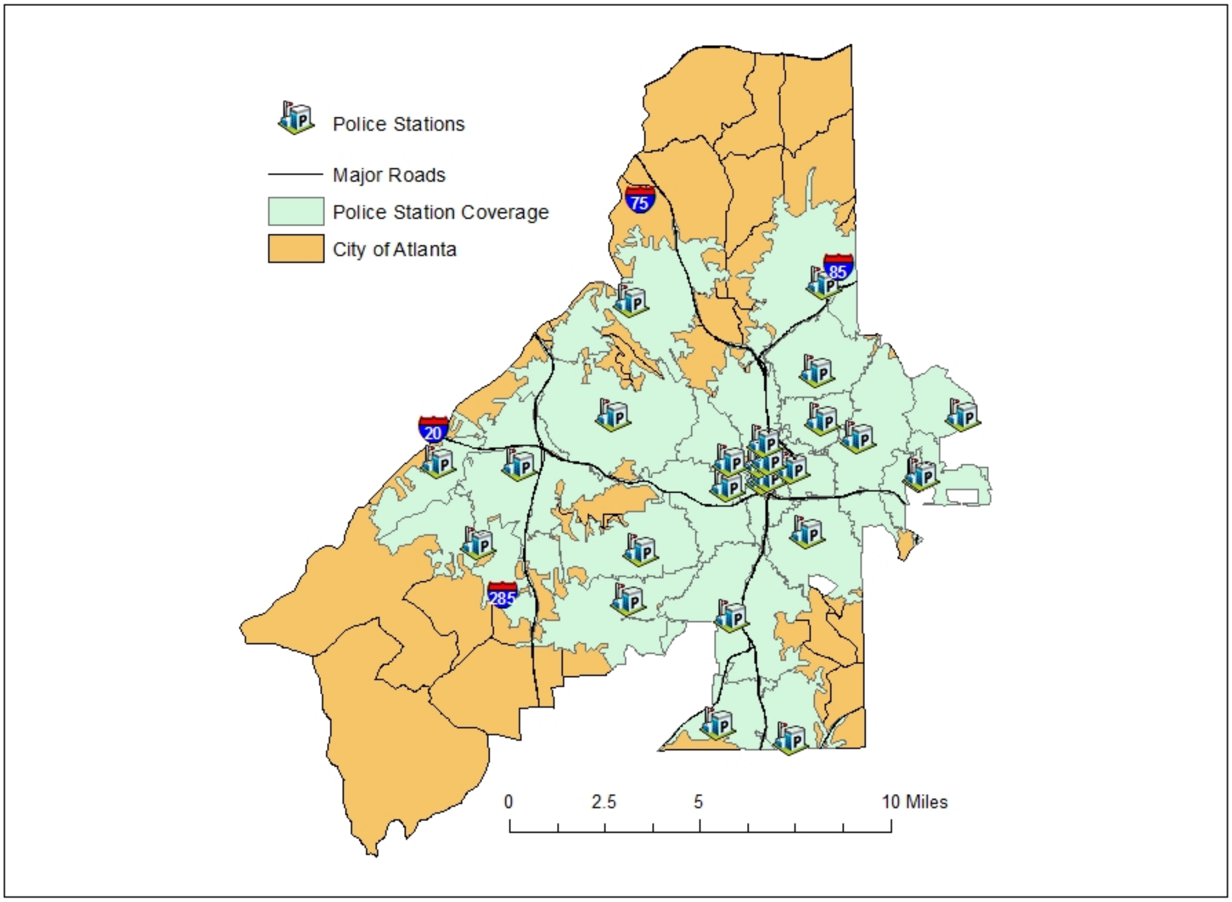

Figure 27 Police Station Coverage Area Polygons

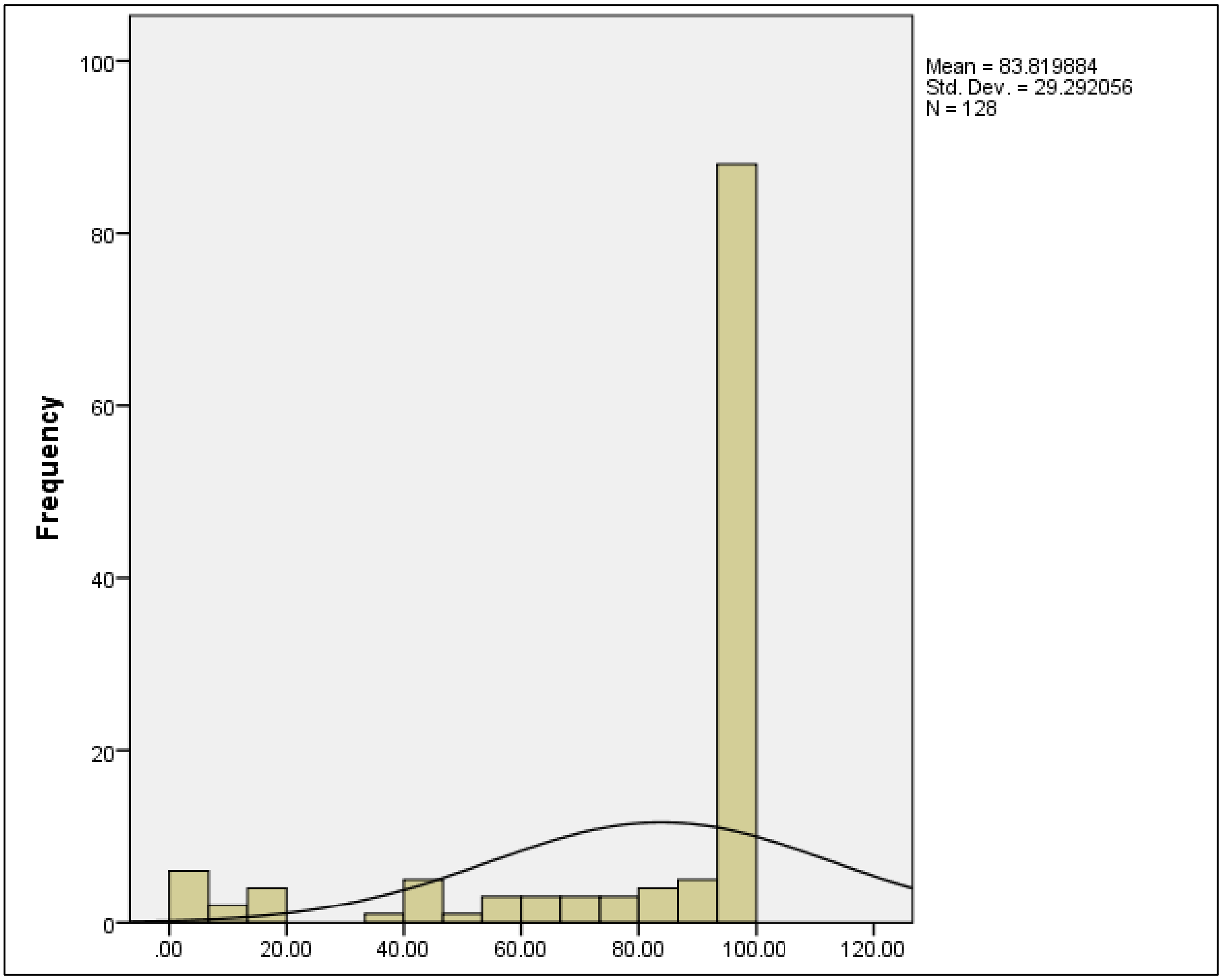

Figure 28 Histogram of Police Station Coverage Area Distribution

The library locations are scattered throughout the city with slight gaps in access. Figure 28 shows the majority of the city having coverage which implies access for the largest portion of Atlanta's residents. A histogram of the library service area ratio coverage is presented in Figure 29. Library coverage is also shown to be skewed positively.

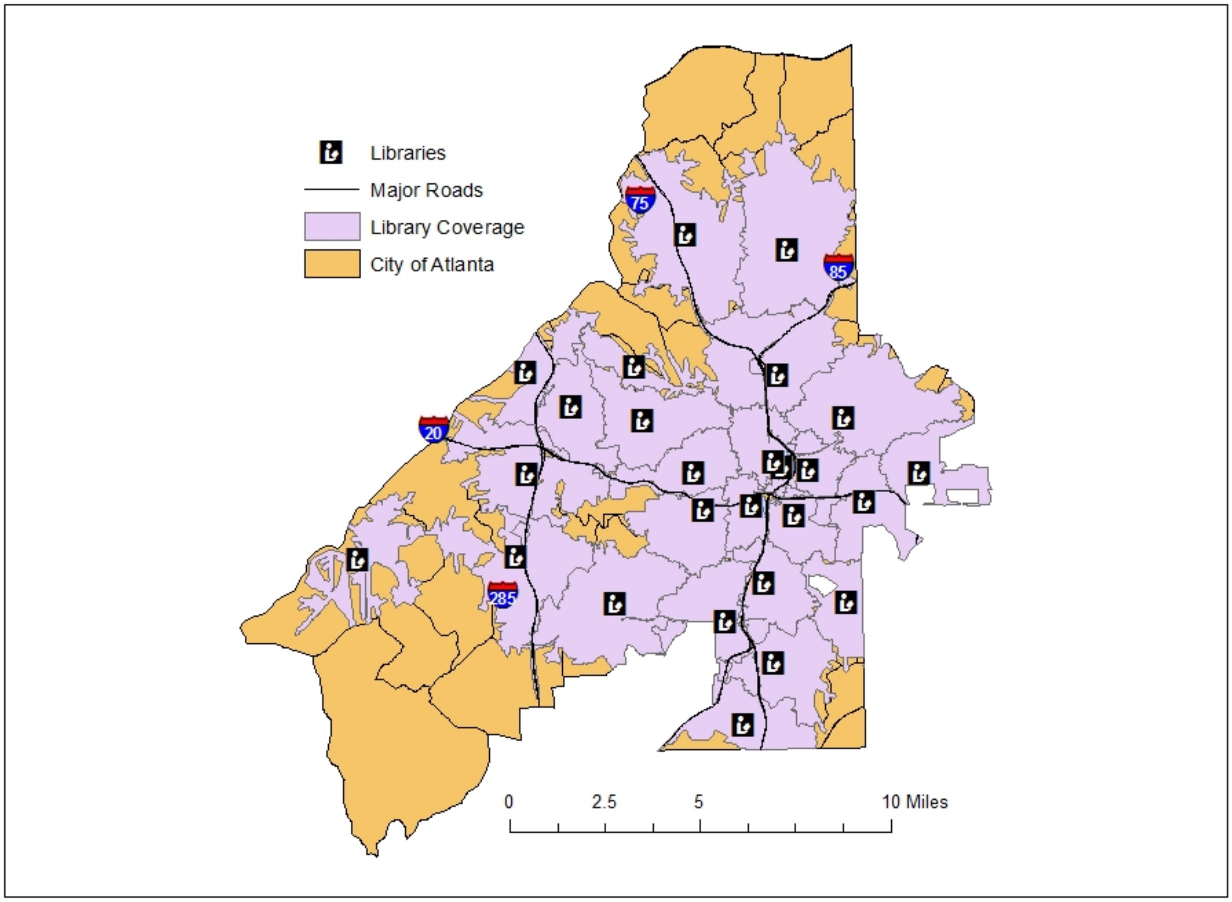

Figure 29 Library Coverage Area Polygons

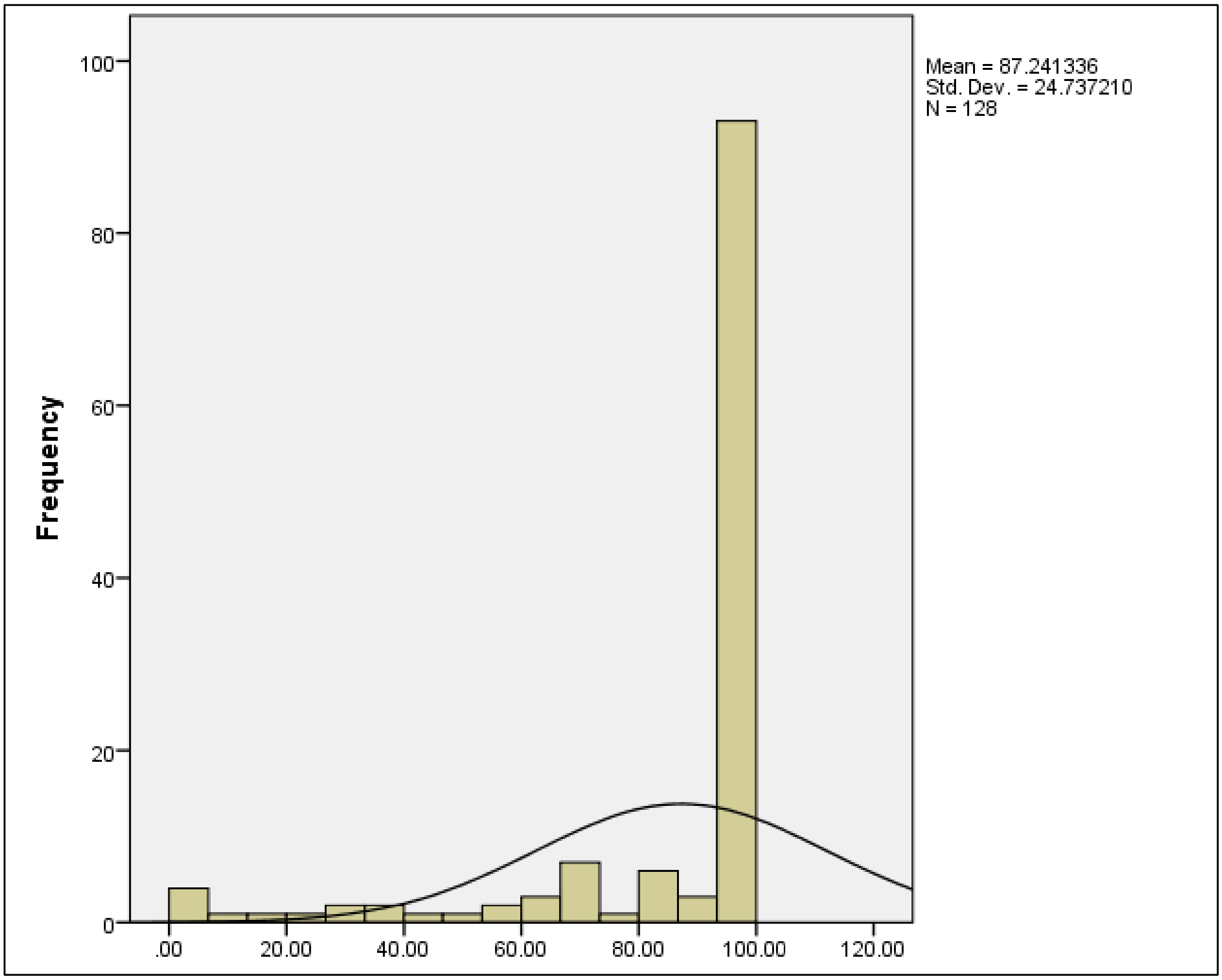

Figure 30 Histogram of Library Coverage Area Distribution

Hospitals locations are very limited within the city as a whole. The map of the hospital service areas is shown in Figure 30. The hospitals are highly clustered around Interstates 75 and 85 with gaps in coverage in the western and southern portions of the city. The histogram, Figure 31, of the hospital coverage ratio shows a bimodal distribution with extremes seen in low and high frequencies of coverage.

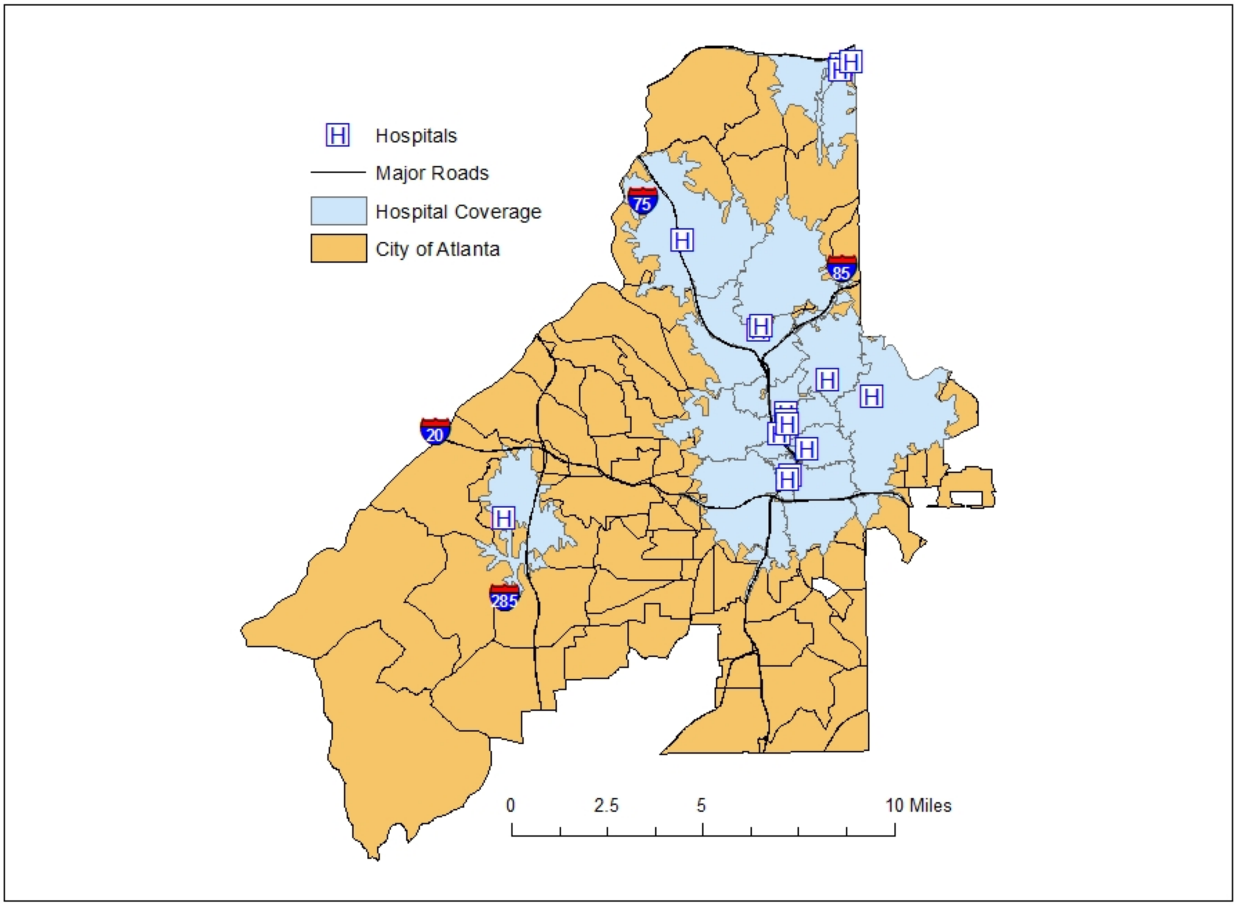

Figure 31 Hospital Coverage Area Polygons

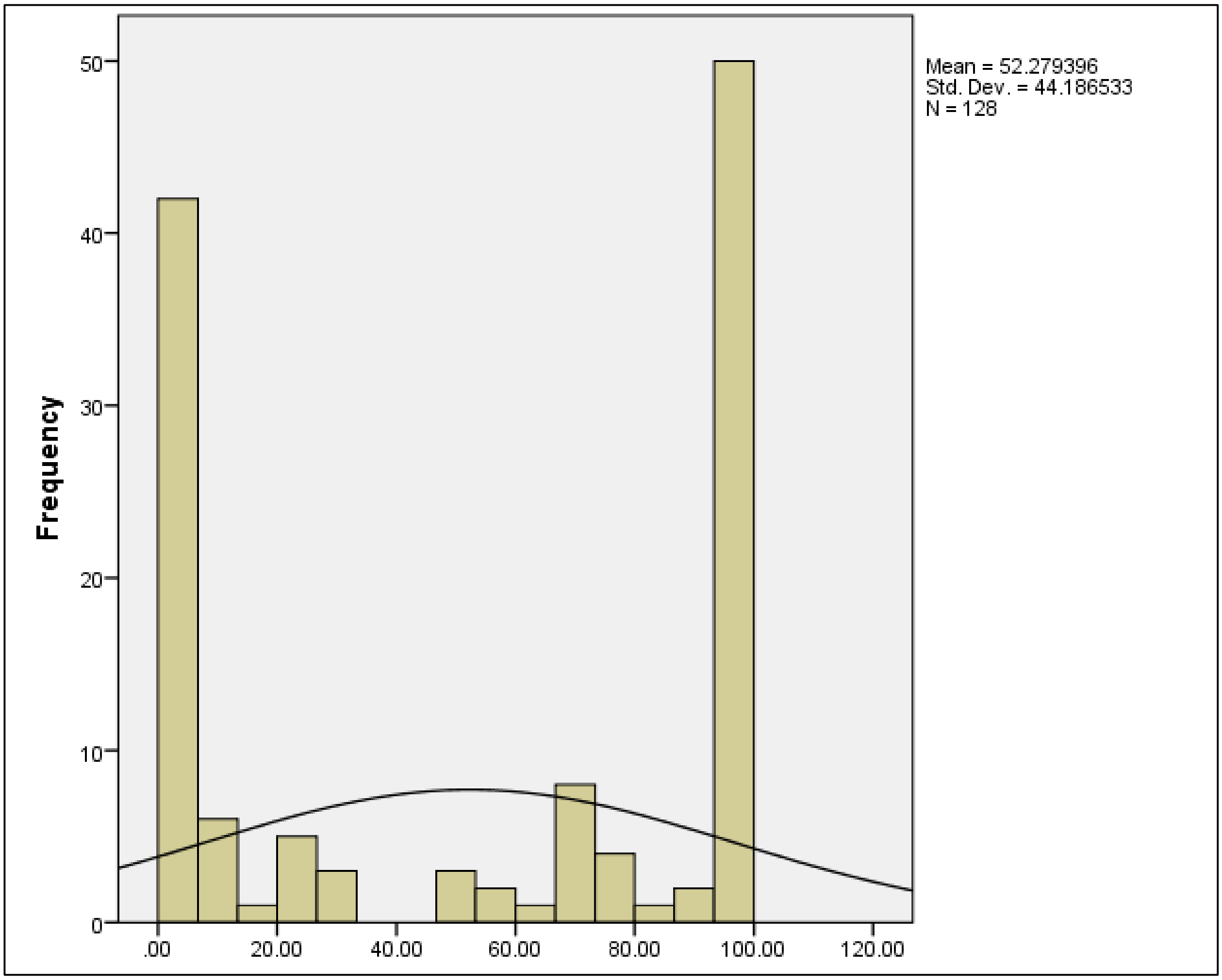

Figure 32 Histogram of Hospital Ratio Coverage Area Distribution

Emergency Rooms are more limited in number than hospitals; their spatial locations, Figure32, reflects the smaller coverage areas. Gaps in emergency room coverage and be seen in the southern and western portions of the city. Figure 33 is a histogram of the emergency room distribution, which is bimodal, like seen with hospitals. The skewness can be seen to be even more so negative with a reduction compared to the hospital histogram in positive frequencies.

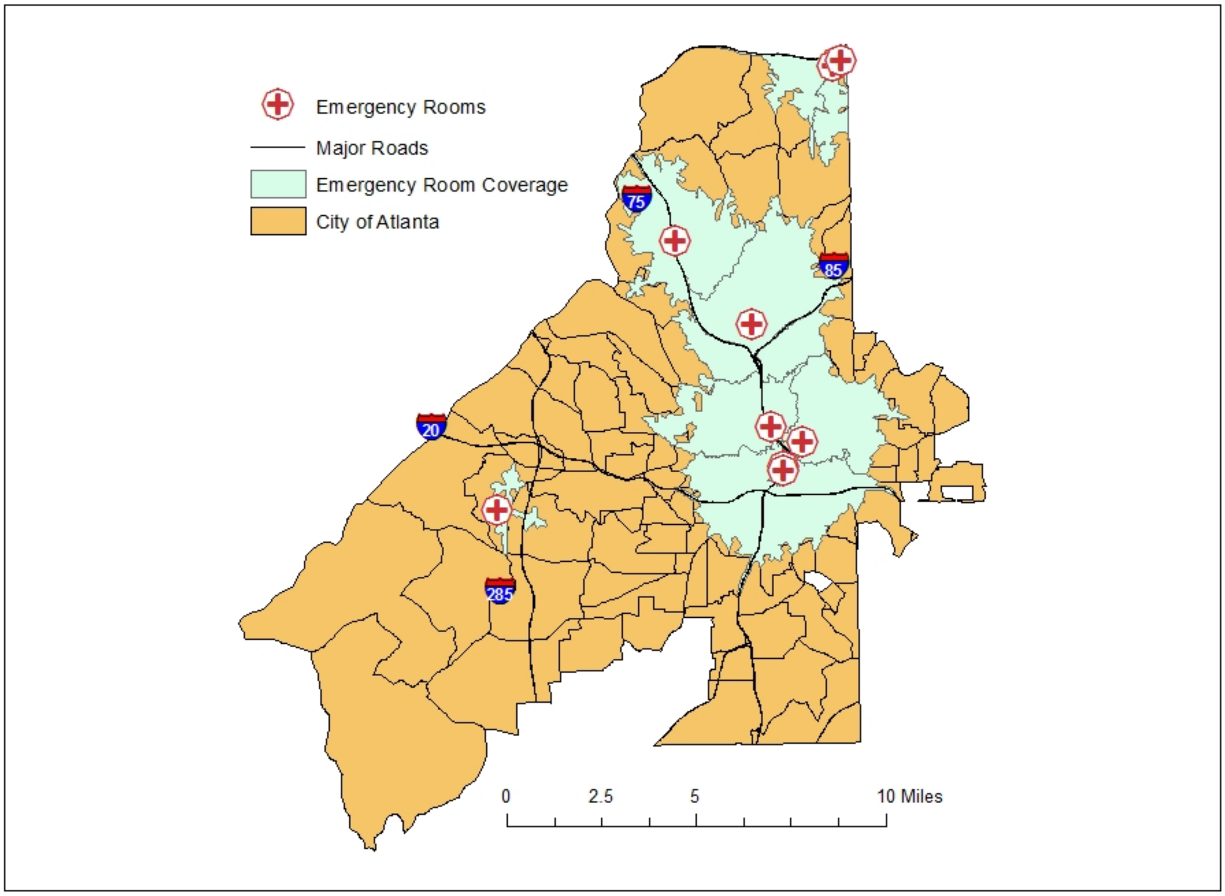

Figure 33 Emergency Room Coverage Area Polygons

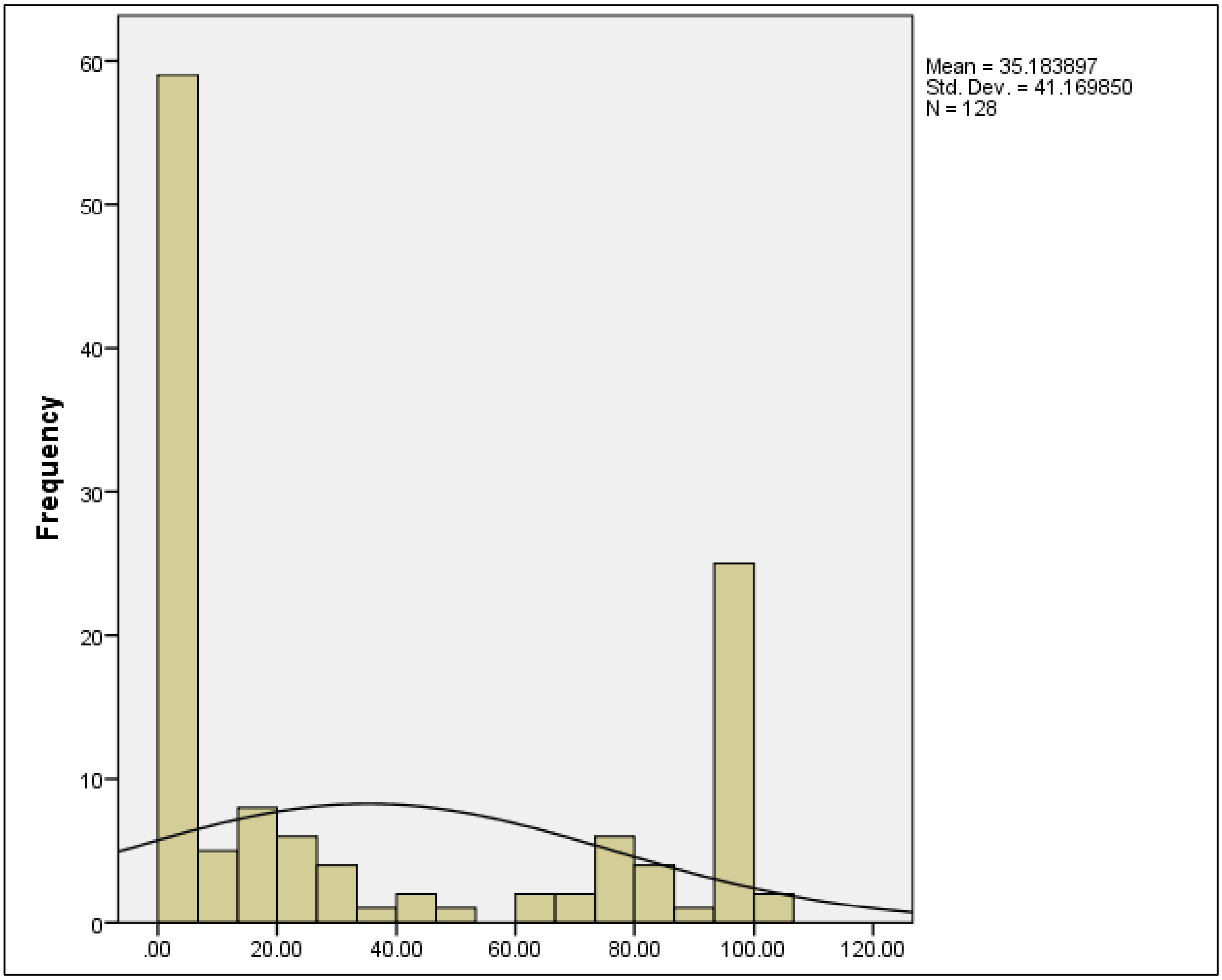

Figure 34 Histogram of Emergency Room Coverage Distribution

4.1.5 Urban Health Index with Six and Four Variables

4.1.5.1 Urban Health Index (UHIv6)

After all calculations were done to obtain the Geometric Mean for the new variables, Fire Stations, Police Stations, Libraries, Not Vacant, Hospitals, and Emergency Rooms, the distribution of the geometric mean was made, Figure 34. The histogram shows the data to be heavily skewed to the left, negatively. Histograms were made independently for each of the variable's ratio coverage in previous sections.

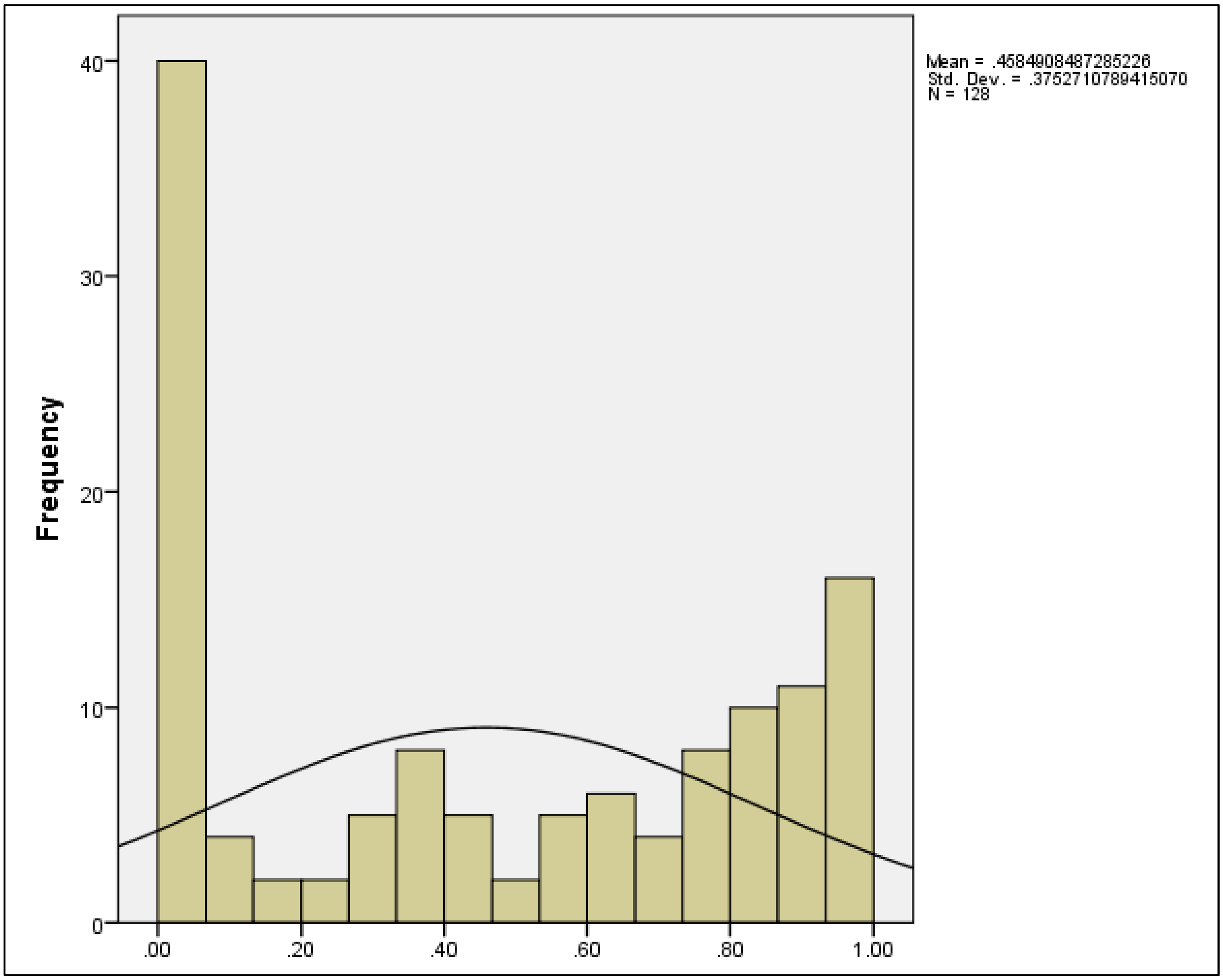

Figure 35 Histogram of Urban Health Index with Six Variables (UHIv6)

The negative skewing was mainly due to the coverage of Hospitals and Emergency Rooms. Hospitals have sixteen facilities in the study area; emergency rooms have ten locations; the number of hospital and emergency rooms has a substantially lower, zero, value for the majority of census tracts values. After the histograms are completed, a choropleth map was made of the UHI with six variables, Figure 35.

The initial visual impression of the map UHI with Six variables shows the majority of census tracts being in the lower values of the UHI with a slight band of higher values seen in the center of the city. This map is very different than original UHIv7. The area of UHIv6 that is shown to hold higher UHI positive values does not correspond with UHIv7's higher value census tracts. The UHIv7's higher values can be seen in the northern most of the city; yet Figure 35 has a center band of high values.

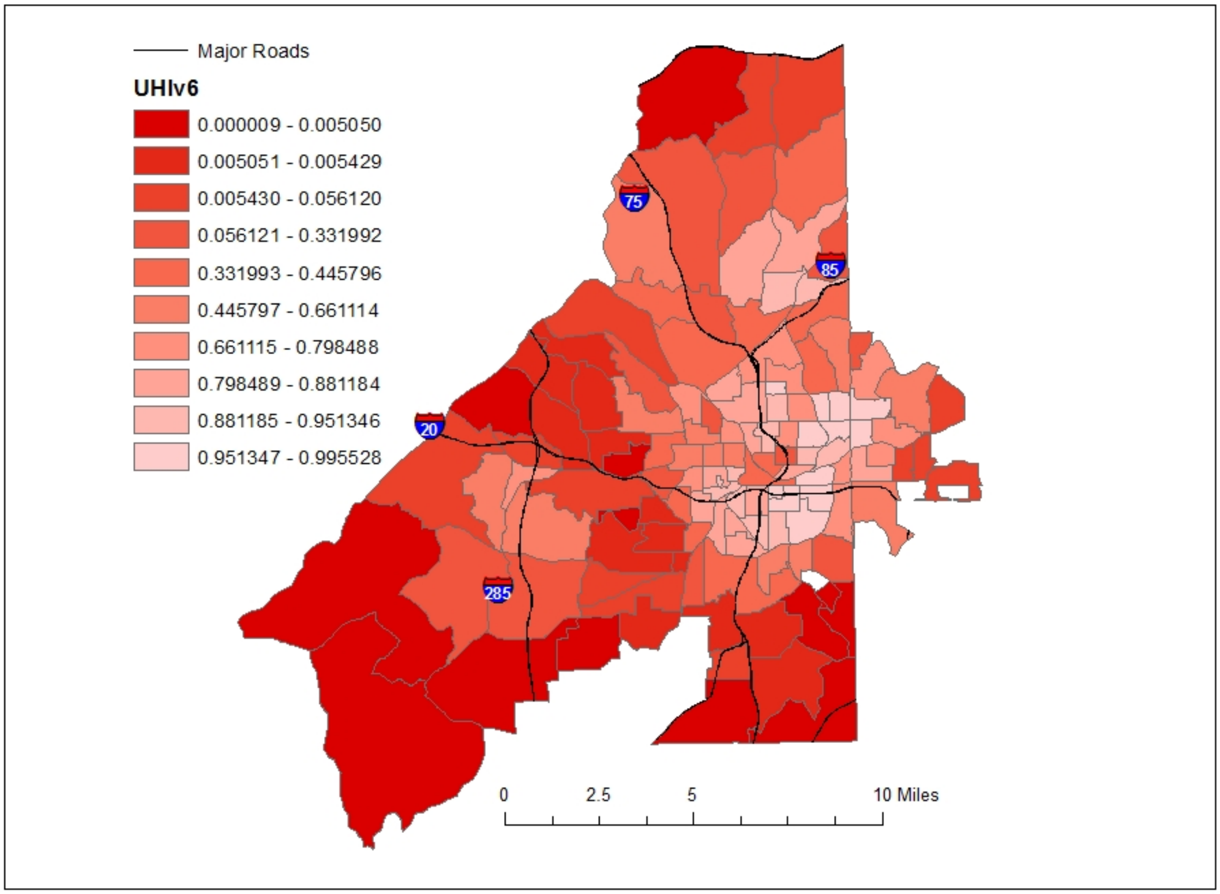

Figure 36 Urban Health Index based on six new Variables (UHIv6)

4.1.5.2 Urban Health Index with Four Variables (UHIv4)

A new geometric mean was calculated following the same methodology as used for the other UHI's using only four standardized variables of fire stations, police stations, libraries, and not vacant.

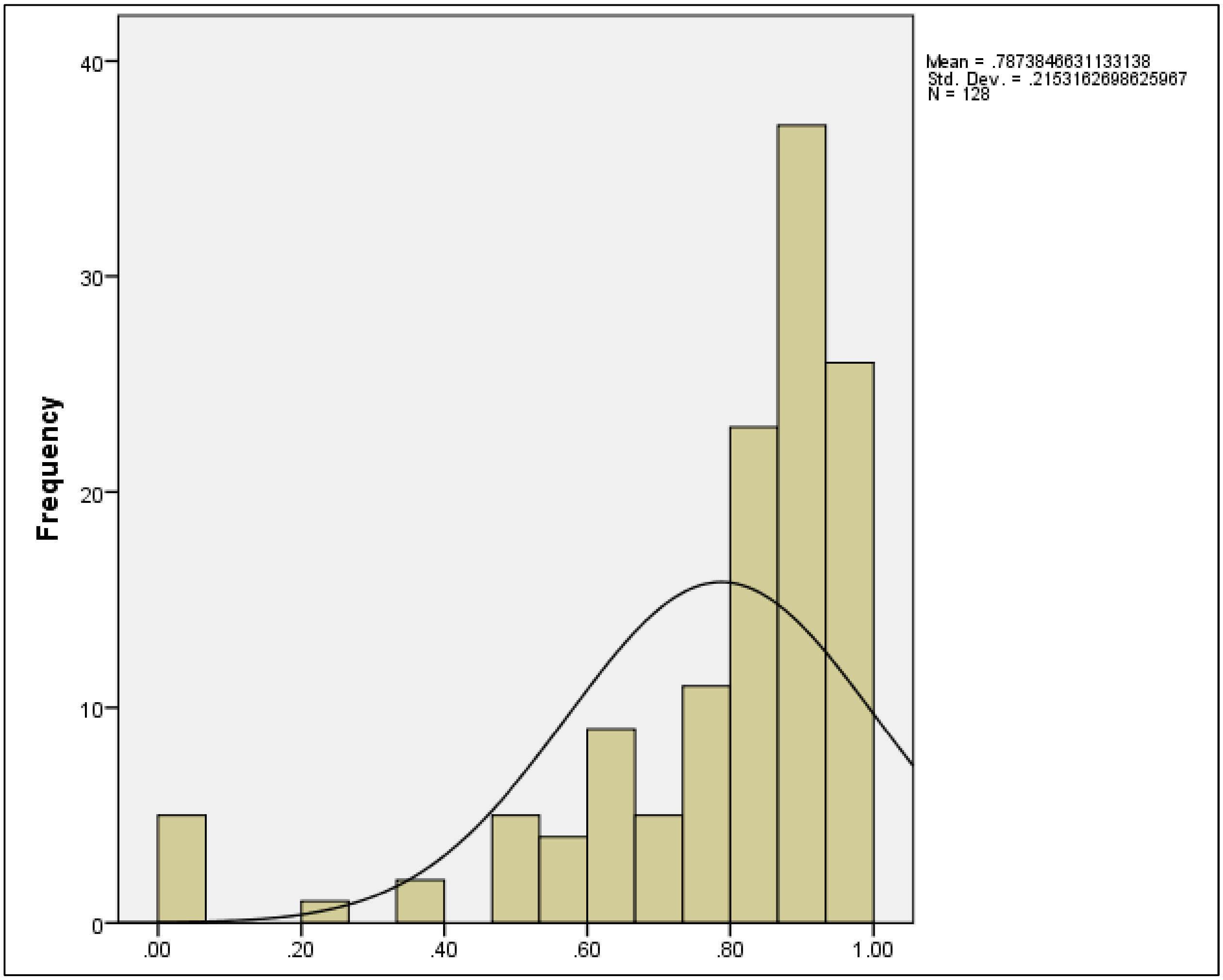

Figure 37 Histogram of Urban Health Index with Four Variables (UHIv4)

This histogram is skewed in the opposite manner, positively, than the UHI with Six variables, Figure 36. The variables were examined to determine what would have been the cause of this skewness. Fire Stations have a very high percentage for coverage areas, out of 128 total census tracts, 114 have a 90% or better UHI value. Police Stations have 90 stations that have a 90% or better UHI values and libraries have 94 census tracts with high UHI values. Not Vacant has a UHI value range of 55-92.

First visual impressions of the map of UHIv4 show the area with the higher UHI values to still be concentrated in the center of the city but much more expansive than UHI with six variables. These findings are not in line with UHIv7 because different UHIs use different variables.

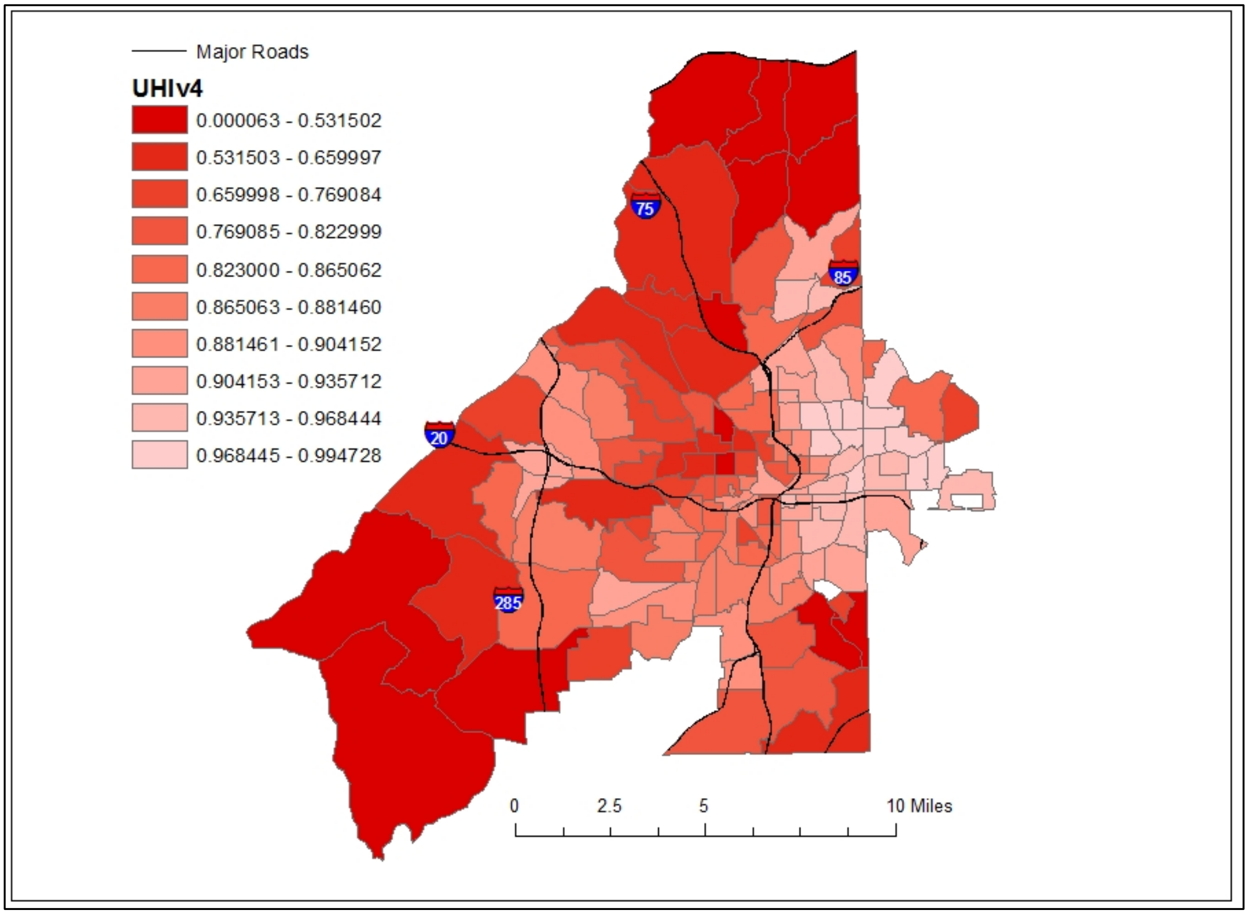

Figure 38 UHIv4 based upon 4 variables (Fire and Police Stations, Libraries, and Not Vacant)

4.1.6 Extremes within the UHIv6

UHI with six variables has positive dataset extremes clustered in the center portion of the city, Figure 38. This is completely opposite of the original UHI, which has the higher UHI values to be in the northern portions of the city. The lowest UHI values are observed in 2, census tracts located closely to Interstate 20. Table 3 summarizes the upper and lower UHI values for UHI with six variables.

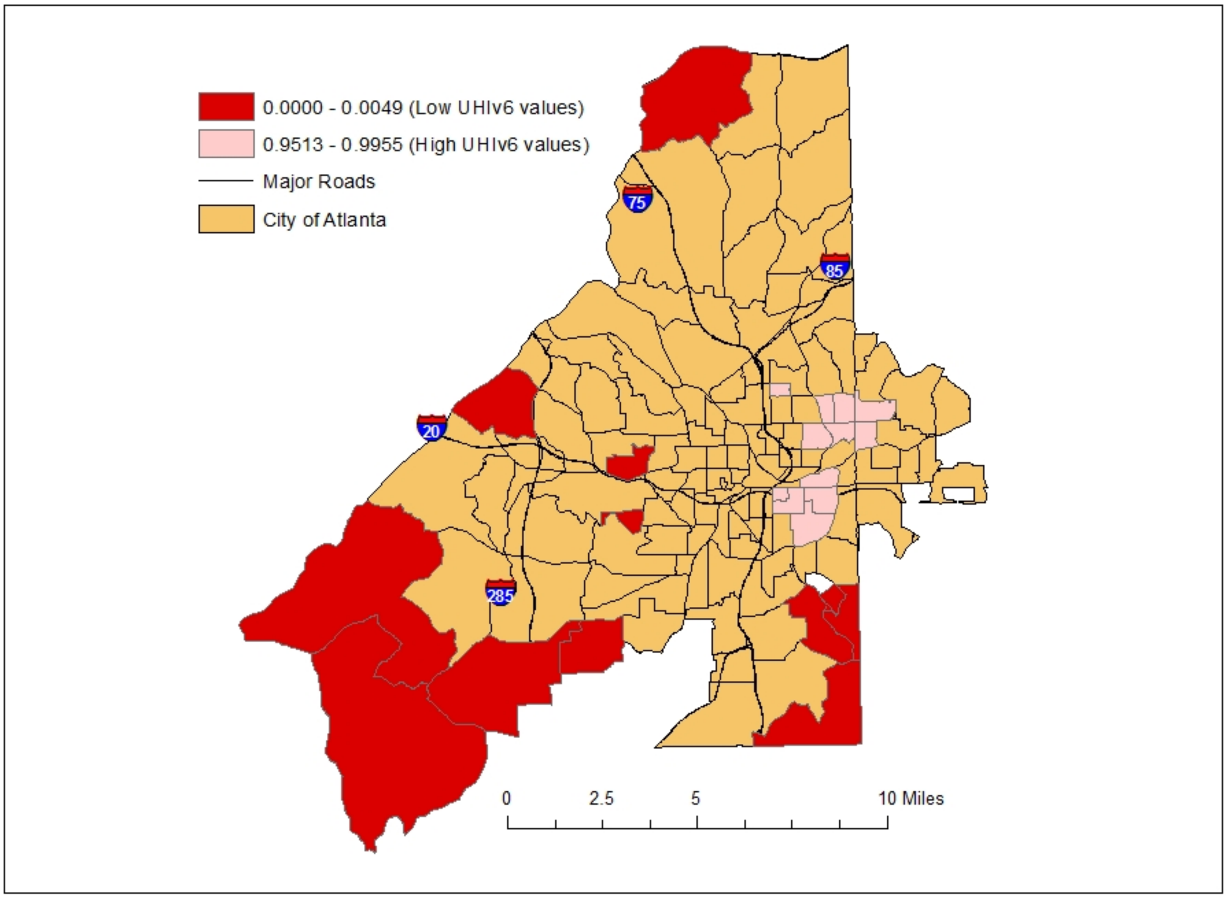

Figure 39 UHIv6 Extreme Upper and Lower Ten Percent of Index

Table 4 UHIv6 Breakdown

UHIv6	Upper 10%	Lower 10%
Number of Census Tracts	12	12
Total Area (mi^2)	5.069638	53.402453
UHIv6 Mean	0.974347	0.003438
UHIv6 Standard Deviation	0.015056	0.001499
Fire Stations	2	5
% Area Covered by Fire Stations	98.875	74.436
Police Stations	2	1
% Area Covered by Police Stations	99.907	32.123
Libraries	2	2
% Area Covered by Libraries	99.907	56.312
Hospitals	1	0
% Area Covered by Hospitals	99.435	0.08
Hospital ER	1	0
% Area Covered by Emergency	98.806	0.0769

room		
Vacancy 2010	12,866	31,351
Vacancy/Area Square Miles	*2,537*	*587*
Brownfields	*9*	*1*
Child Molesters	*2*	*9*

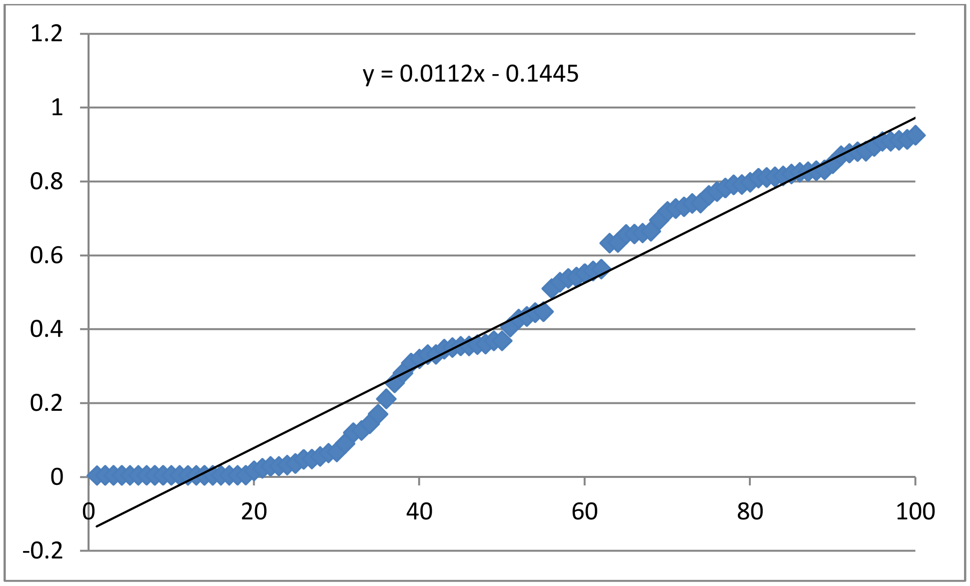

Figure 40 Slope of the Midsection of UHIv6

Based upon Table 3, the health disparities ratio was calculated, the mean of the upper ten percent of the census tracts divided by the mean for the lower ten percent of the census tracts, to be 283.41. The slope is 0.0112.

4.1.7 Extremes within UHIv4

Adjusting the variable count resulted in the UHI with four variables caused the extremes seen within the upper and lower ten percent of the UHI values to shift. The lighter hues are clustered on the east side of the study area, (Figure 40). The majority of the census tracts in the upper northern portion of the city have completely opposite UHI values. Table 4 gives a breakdown of more detailed information about the upper and lower deciles of the Index.

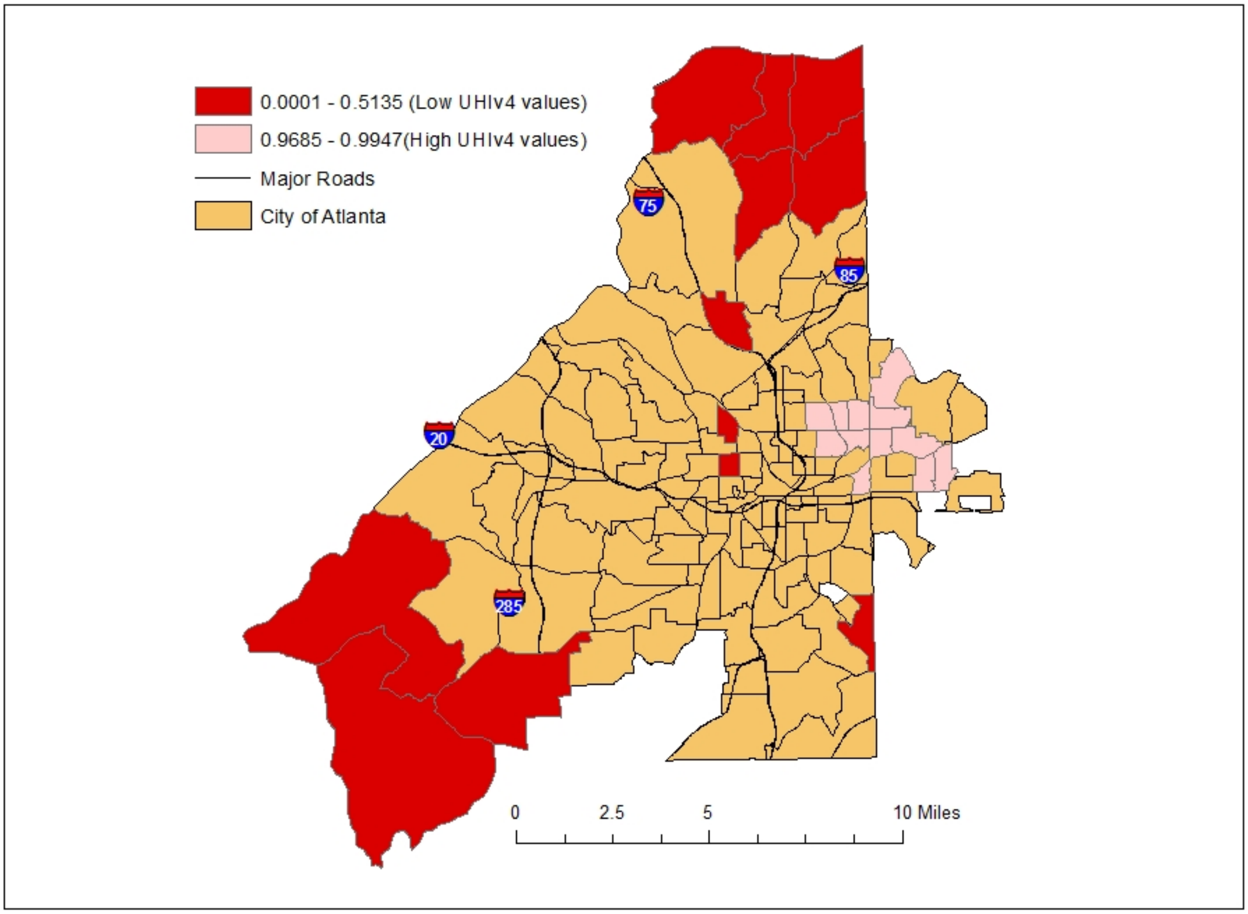

Figure 41 UHIv4 Extreme Upper and Lower

Table 4 UHIv4 Breakdown

UHIv4	Upper 10%	Lower 10%
Number of Census Tracts	12	12
Total Area (mi^2)	6.171744	57.781815
UHIv4 Mean	0.981735	0.252424
UHIv4 Standard Deviation	0.007314	0.218354
Fire Stations	4	5
% Area Covered by Fire Stations	99.95	75.02
Police Stations	4	1
% Area Covered by Police Stations	99.67	21.18
Libraries	2	2
% Area Covered by Libraries	99.69	48.75
Vacancy 2010	12,118	33,109
Vacancy/Area Square Miles	*1,963.4645*	*573.297*
Brownfields	*10*	*4*
Child Molester	*4*	*7*

After reducing the variables, the health disparities ratio was determined to be 3.89, which is a substantially difference from UHIv6's health disparity ratio. The health disparity slope was determined to be 0.0035.

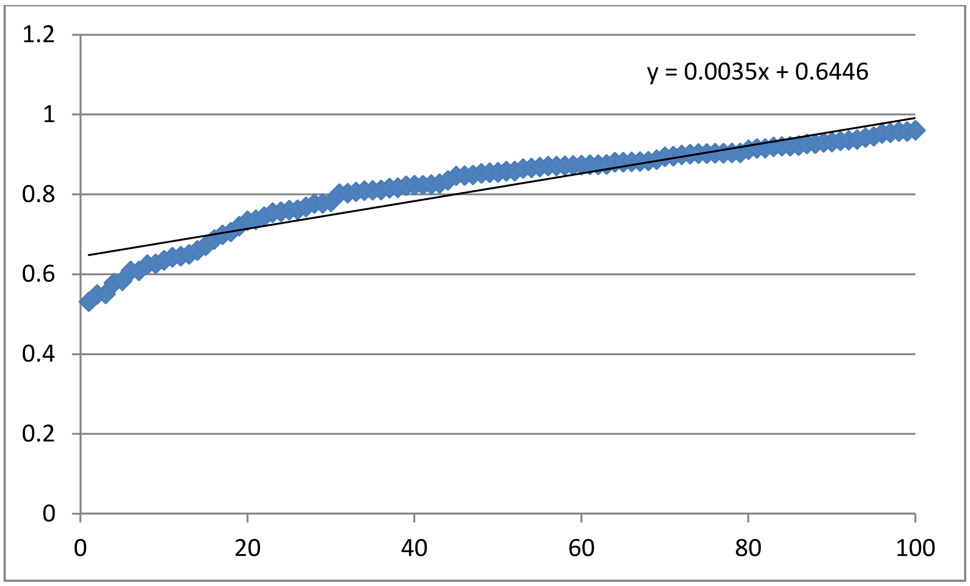

Figure 42 Slope of the Midsection for UHIv4

5 DISCUSSION

5.1 Extremes within all UHIs Census Tract

Several of the census tracts are explored in further detail due to their UHI results for all three UHIs (UHIv7, UHIv6, and UHIv4). The three UHI value maps were compared in terms of the upper and lower deciles of the Index. Five census tracts were investigated by their UHI value variances. The first tract, 13121000800, has similar low UHI values for all three UHI maps. Census Tract, 13121001600, has similar higher UHI values. The next census tracts, 13121009000 and 13121007808, hold high variability between all of the UHIs created. In order to review the census tracts, street and Ariel maps of each census tract were obtained, (Figures 42-56).

5.1.1 Census Tract 13121008000

Census tract 13121008000 is one of the few locations in which the three UHIs findings are somewhat succinct as lower, UHIv7 value (0.1869), UHIv6 (0.0909), and UHIv4 (0.0274). This information suggests that this tract is lacking in multiple manners. Based upon the chosen variables, this tract has lower median incomes, not many residents with higher education degrees, higher numbers of vacancies and female headed households, low access or coverage of fire stations, police stations, libraries, hospitals, and emergency rooms.

Figure 43 Street Map of Census Tract 13121008000

Figure 44 Ariel Map of Census Tract 13121008000

Overall, this tract is thought to have a lower quality of life based upon the previous maps. Figure 44 shows all of the point locations on and near the census tract. A large number of brownfields, 8, are present or in close proximity to the tract. This information leads to the further reduction in the general quality of life for these tract residents.

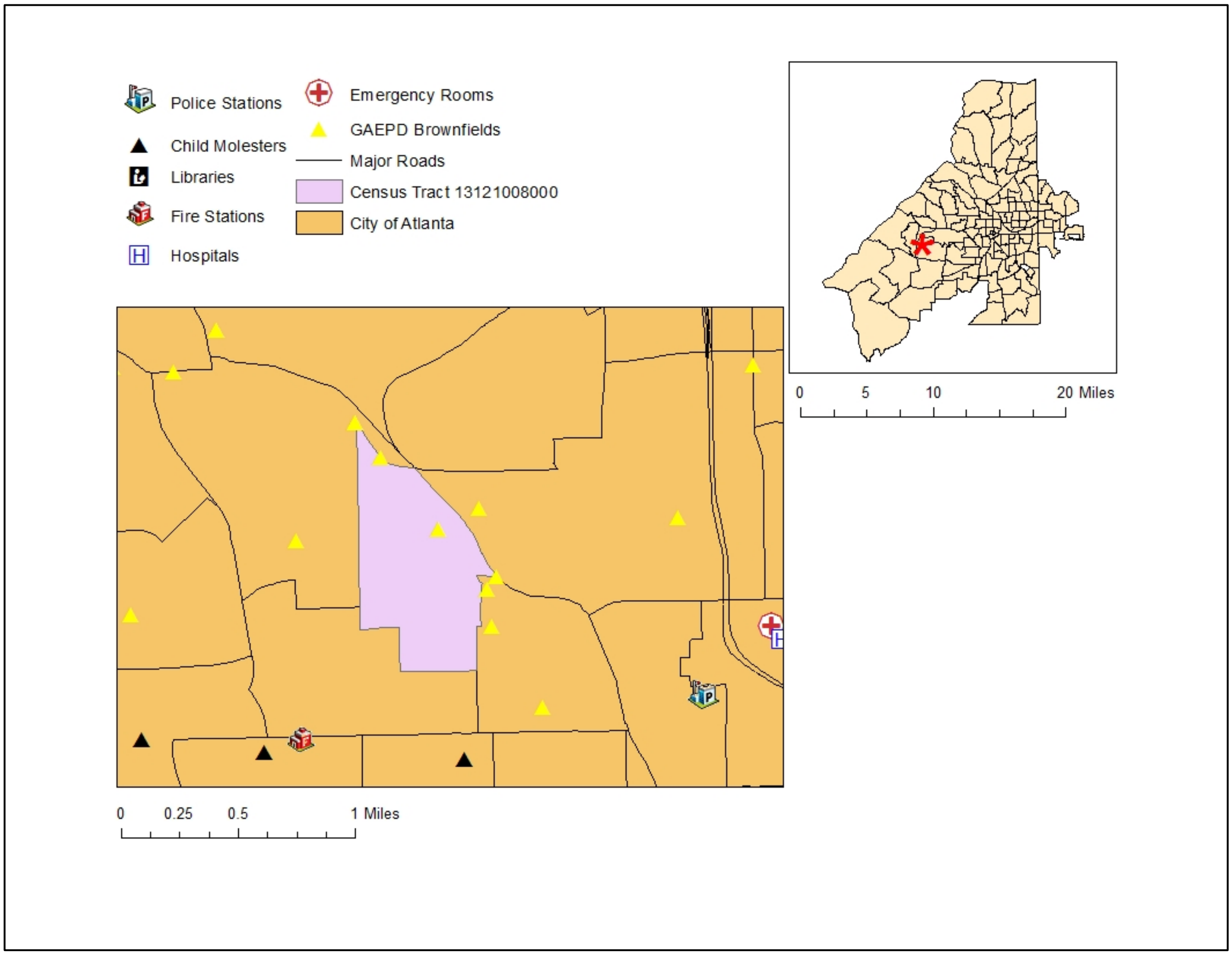

Figure 45 Census Tract 13121008000 Map with Point Locations

5.1.2 Census Tract 13121001600

Census tract 13121001600 has similar high UHI values, UHIv7 (0.620) UHIv6 (0.9888) and UHIv4 (0.9833). The area of census tract 13121001600 is 0.355293 mi^2. This tract is shown to have higher median incomes, higher educated, with at least one fire station, police station, library, hospital, emergency room, and lower numbers of vacancies, female headed households, GAEPD brownfields and child molesters. Figure 44 displays the street map of census tract 13121001600. The center of the street map shows a substantial area allotted to one single facility, Carter Presidential Library and Presidential Center. The Ariel map shows the northern most portion of the tract to hold single family residential with a moderate amount of green spaces seen more to the southern part of the tract.

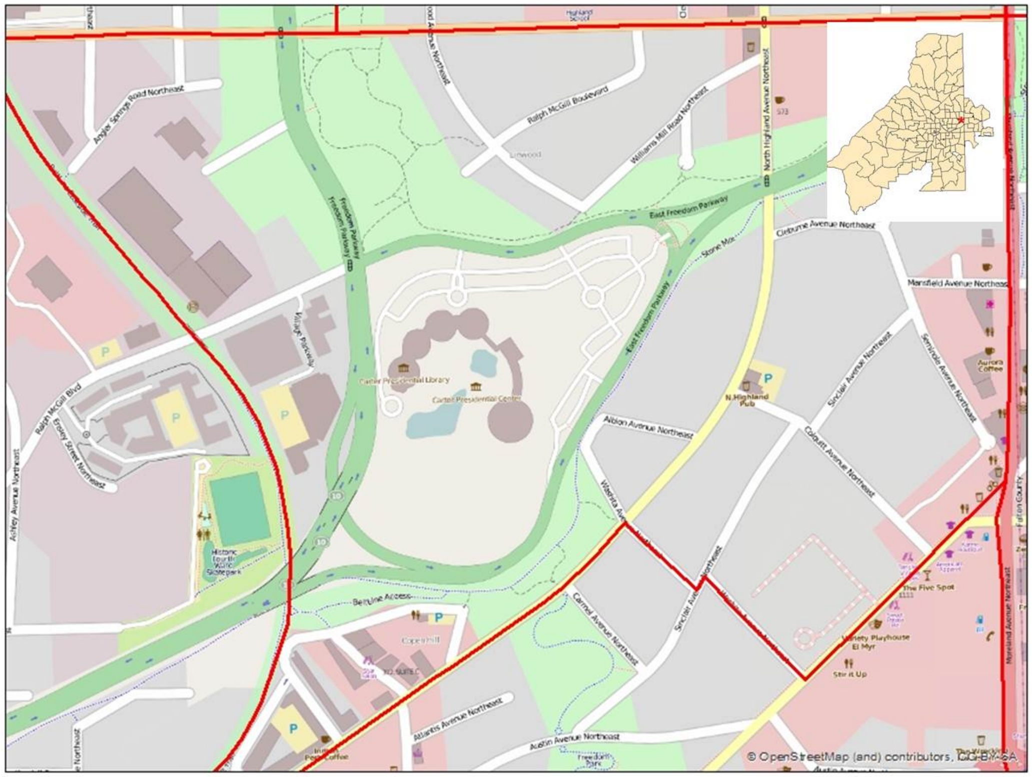

Figure 46 Street Map of Census Tract 13121001600

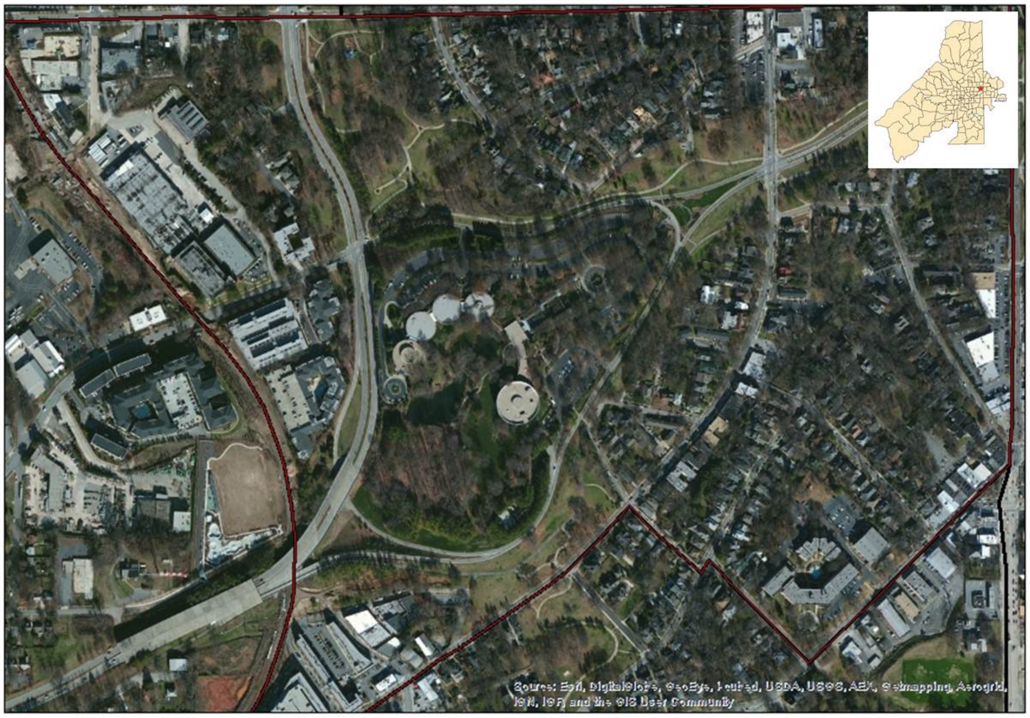

Figure 47 Ariel Map of Census Tract 13121001600

Taking into consideration all of the variables, along with the large size of the Carter Library and Presidential Center, this tract has been shown to have a better quality of life of its residents. The only negative impacts would be the number of brownfields, 1, and child molesters, 1, but even these are highly limited in the tract. The negative issues are not enough to alter the general trend of the tract as having a better quality of life.

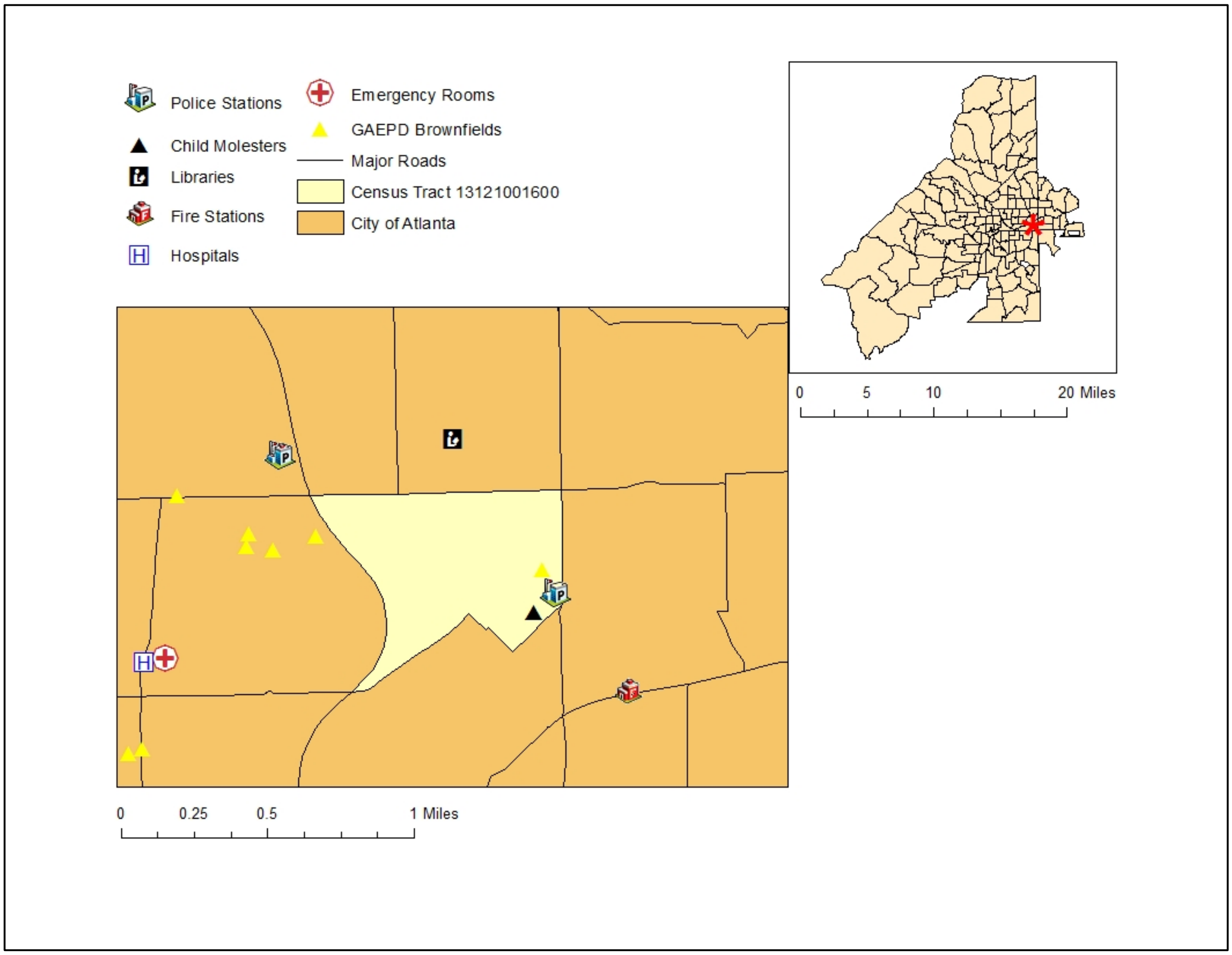

Figure 48 Census Tract 13121001600 Map of Point Locations

5.1.3 Census Tract 13121009000

Census tract 13121009000 has wide variability between the three different UHIs, UHIv7 (0.7876), UHIv6 (0.2817), and UHIv4 (0.5134). This tract is 1.254407 mi^2. The street map of the tract shows Atlanta Memorial Park and Bobby Jones Golf Course to be located towards the northern part with multiple roadways throughout the tract. Another Golf Club, Cross Creek, is located near the upper western side of the tract. The Ariel map displays large portions of green spaces along with residential living locations.

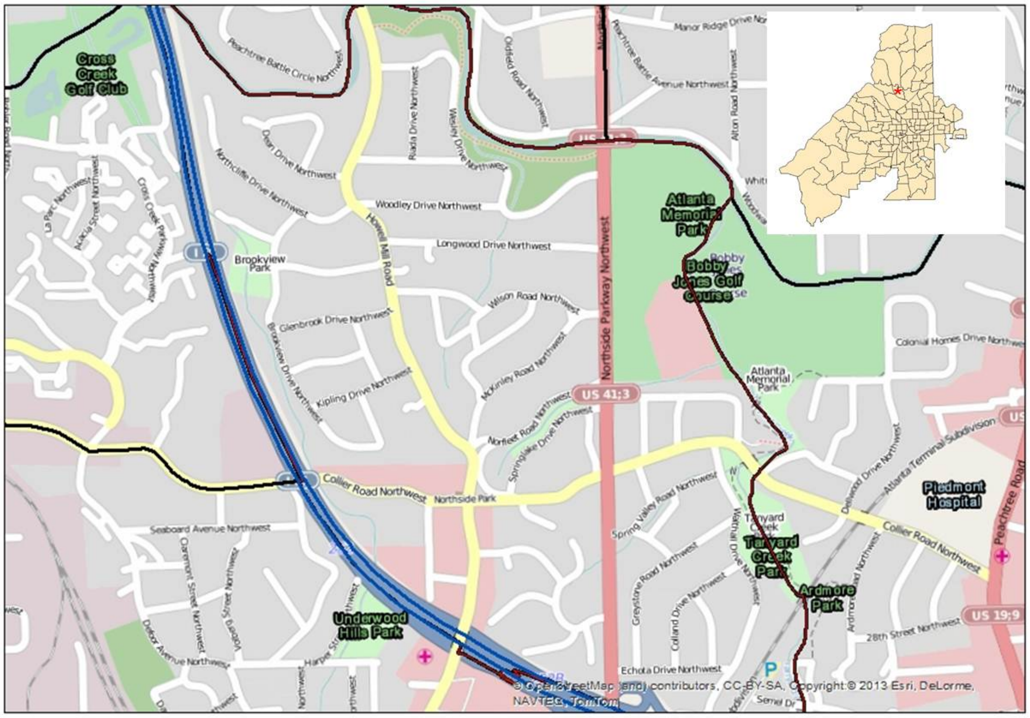

Figure 49 Street Map of Census Tract 13121009000

UHIv7's value of 0.7876 relays the idea that the residents of this tract holds higher education degrees, is not headed by females with children under the age of 18 years old, have higher median incomes, due to most residents are employed. UHIv6's value of 0.2817 emphasizes the lack of hospital and emergency room access because when removed from the calculation the result is an increase in the UHI value, UHIv4 (0.5134).

Figure 50 Ariel Map of Census Tract 13121009000

In general, this tract would be considered to have a better quality of life because of the higher UHIv7 values. UHIv6 and UHIv4 are dramatically impacted by the hospital and emergency room variables. Figure 50 shows hospitals that are in close proximity to the tract. No brownfields or child molesters are within the tract and little to none in close proximity of the tract, which is a positive contributor to the general quality of life of the tract.

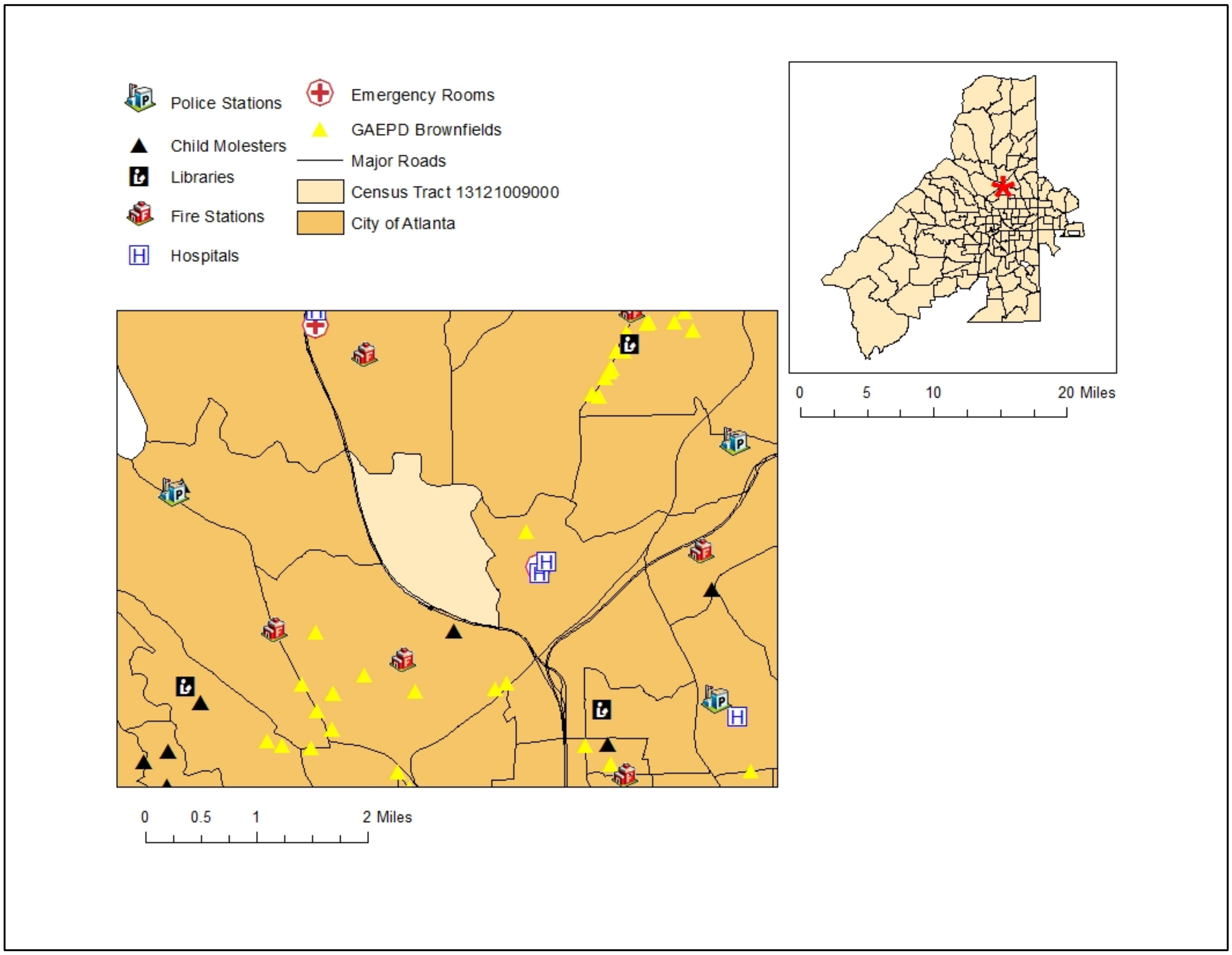

Figure 51 Census Tract 13121009000 Map of all Point Locations

5.1.4 Census Tract 13121007808

Census tract 1312100900 also has wide variability between the UHIs, UHIv7 (0.1019), UHIv6 (0.7413), and UHIv4 (0.9226). The tract is very oddly shaped and has a total area of 0.630868 mi^2. The street map, Figure 51, shows limited roadways with a large green space located on the southern tip of the tract and a large shopping center along the northern border. The Ariel map, Figure 52, displays the greenspace very well along with residential living.

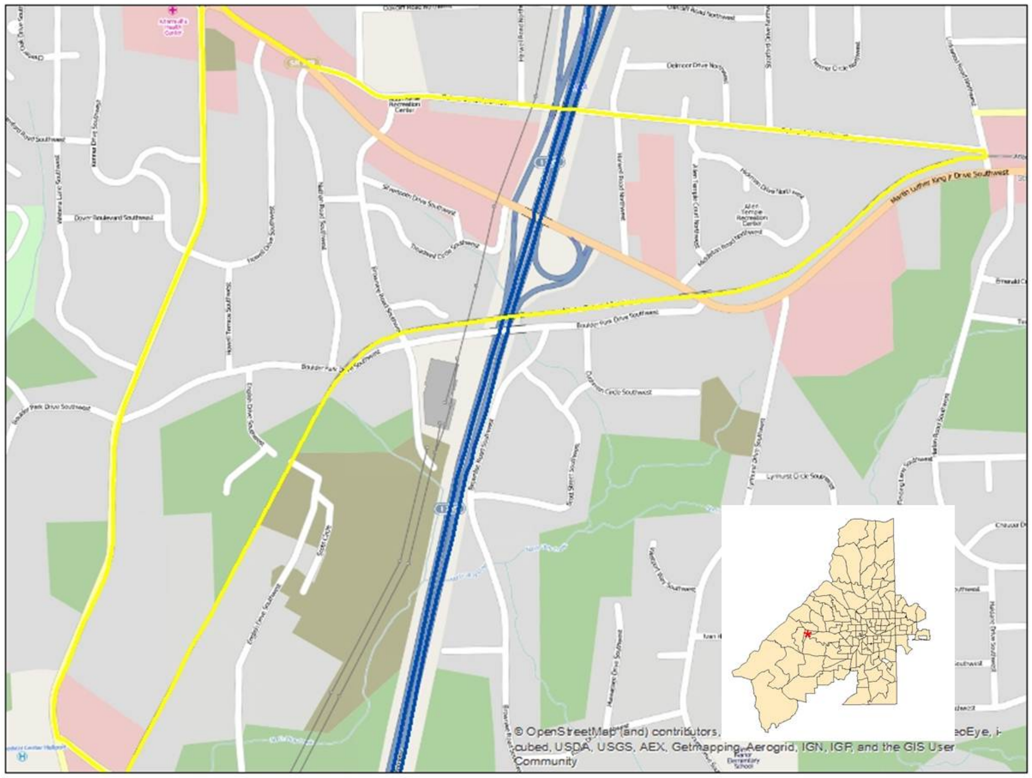

Figure 52 Street Map of Census Tract 13121007808

Based upon UHIv7’s assessment (0.1019), this tract is thought to have a lower quality of life due to lower numbers of residents with higher degrees, employed, higher numbers of female headed households with children under the age of 18 years of age, lower median and mean incomes. UHIv6’s value of 0.7413 suggests a better quality of life due to the high percentage fire and police stations, libraries, hospitals and emergency rooms with low vacancies. Even with the hospitals and emergency rooms removed and the UHIv4 is determined to be 0.9226, the result is an increase in the UHI values.

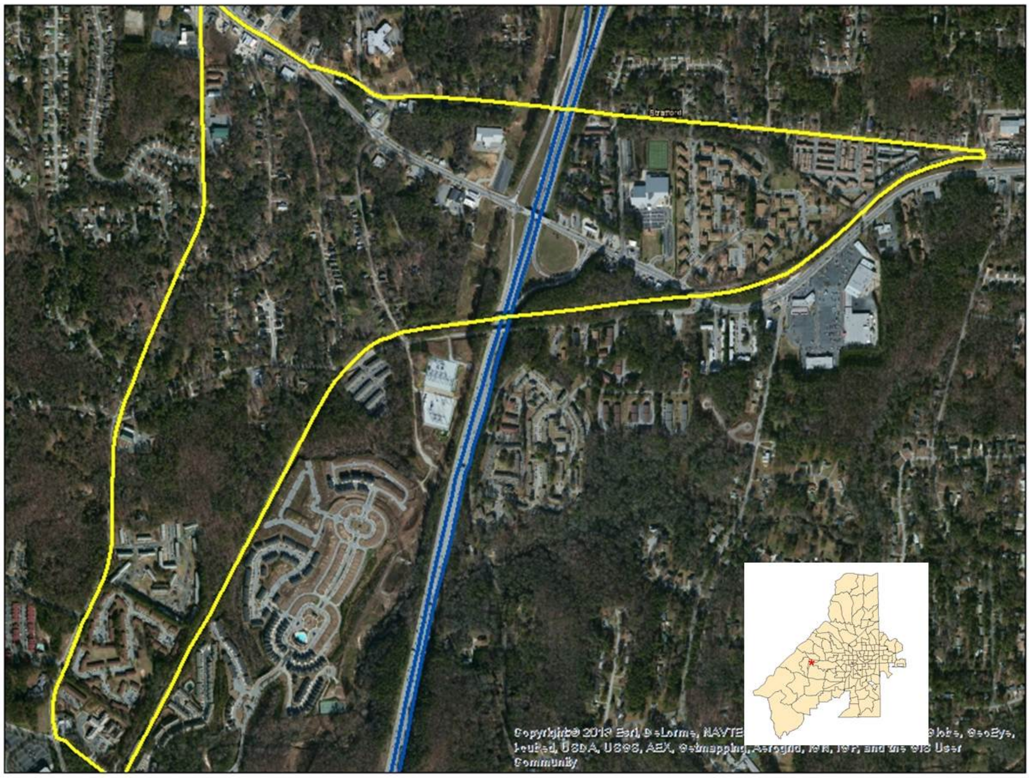

Figure 53 Ariel Map of Census Tract 13121007808

The general trends of this tract are quite different for each of the UHIs resulting in determining the general trend for the county to be difficult. Figure 53 shows all the point locations within the tract or in close proximity to the tract. The tract has several positive points either within or very close to the tract. Negative impacts are not seen within the tract but three child molesters reside just north of the tract. In general all three of the UHIs may not adequately describe the experience of the residents.

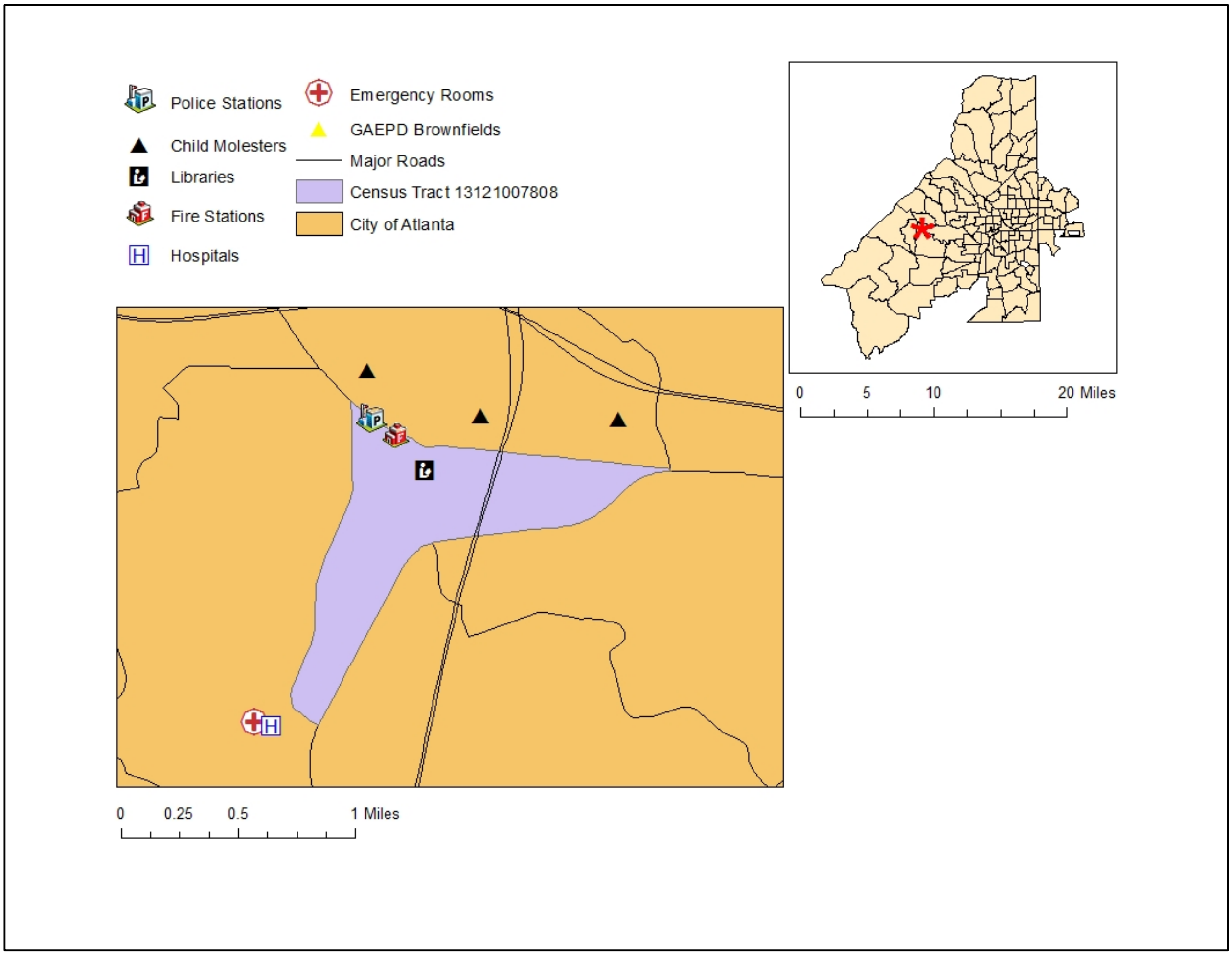

Figure 54 Census Tract 13121007808 Map with Point Locations

5.1.5 Census Tract 13121002300

Census Tract 13121002300 shows high variability between UHIs, UHIv7 (0.1687), UHIv6 (0.6584), and UHIv4 (0.5784). This tract is 0.434238mi^2. The street map shows an over view of the area with the large portion on the south western side of the tract to be allotted to the railways; the Ariel map shows no other large facilities.

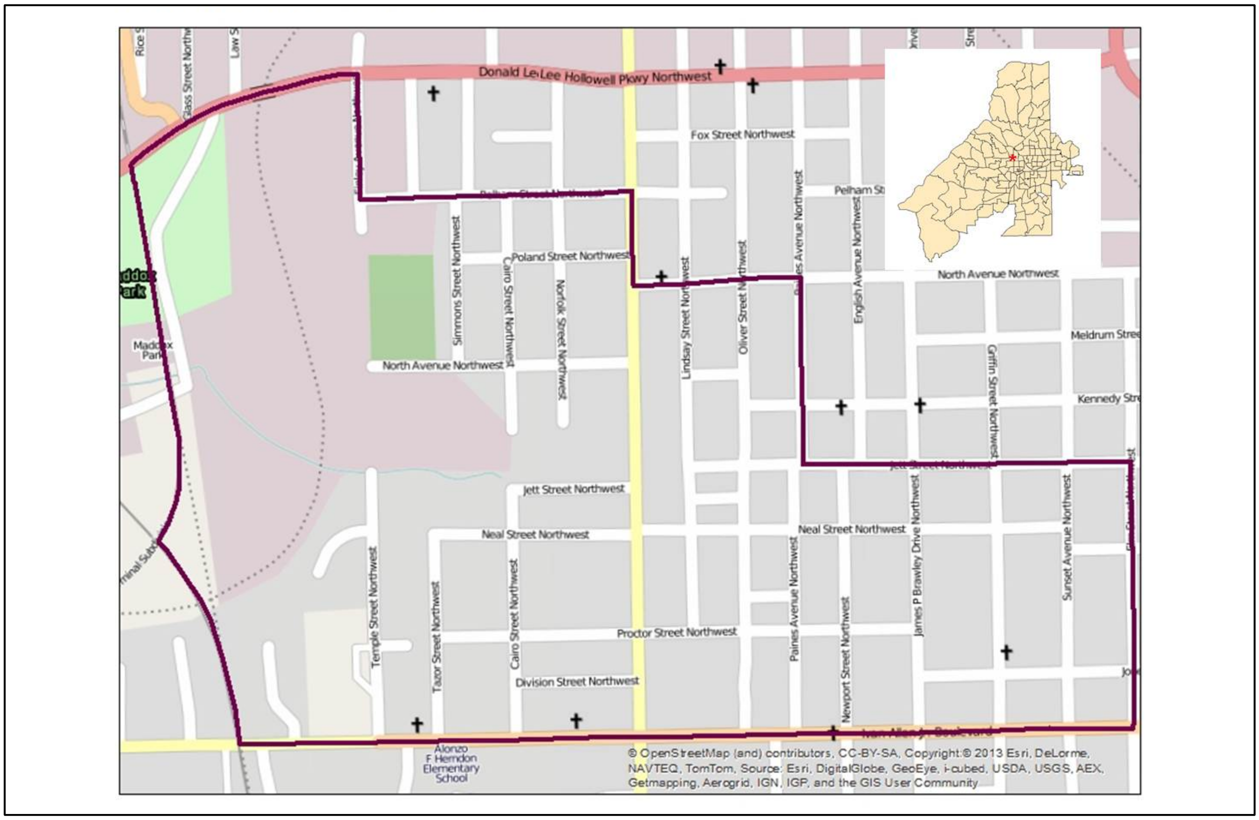

Figure 55 Street Map of Census Tract 13121002300

With an UHIv7 value of 0.1687, this census tract is thought to have higher numbers of not employed, female headed households with children under the age of 18 years old, median and mean incomes; all of which imply a lower quality of life. UHIv6, 0.6584, relates a more positive experience for the residents due to the higher numbers of positive locations. UHIv4, 0.5784, was reduced by the removal of the hospital and emergency room locations.

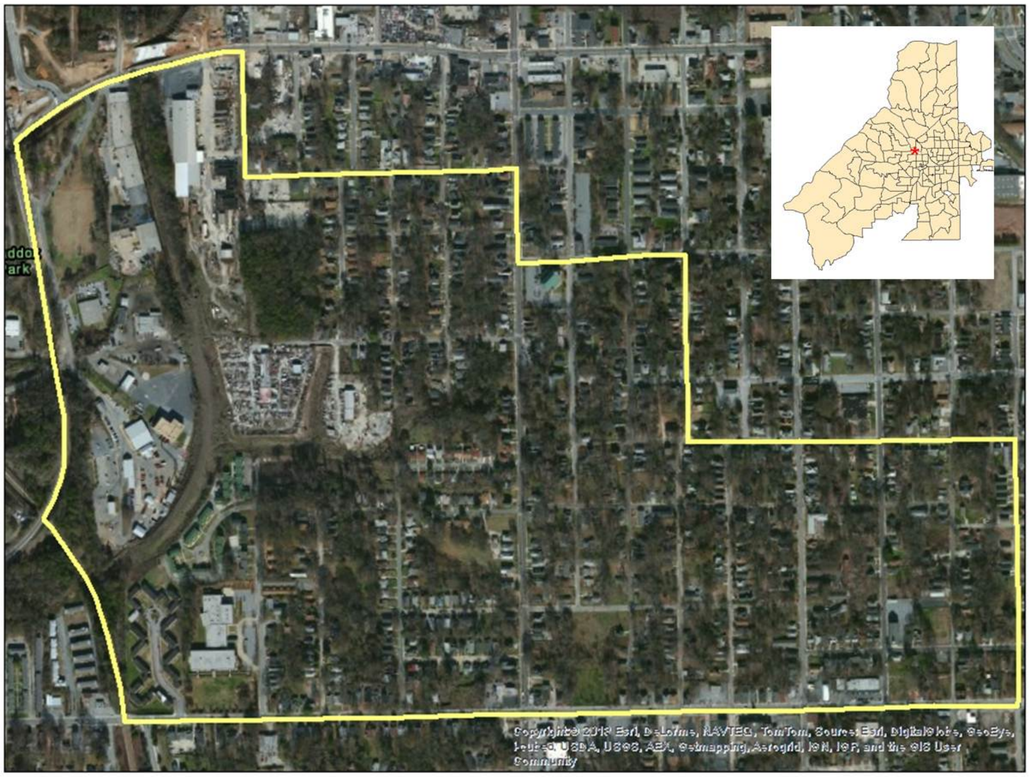

Figure 56 Ariel Map of Census Tract 13121002300

The general trend for the quality of life experienced in this tract is also hard to determine because of the variance between the UHIs. Figure 56 displays all of the point locations with little to no positive or negative impacts within the tract. Around the tract in a fairly close proximity are negative variables of brownfields and child molesters but with limited numbers. As seen with census tract 13121007808, none of the UHIs may explain the living experience of the residents in the tract.

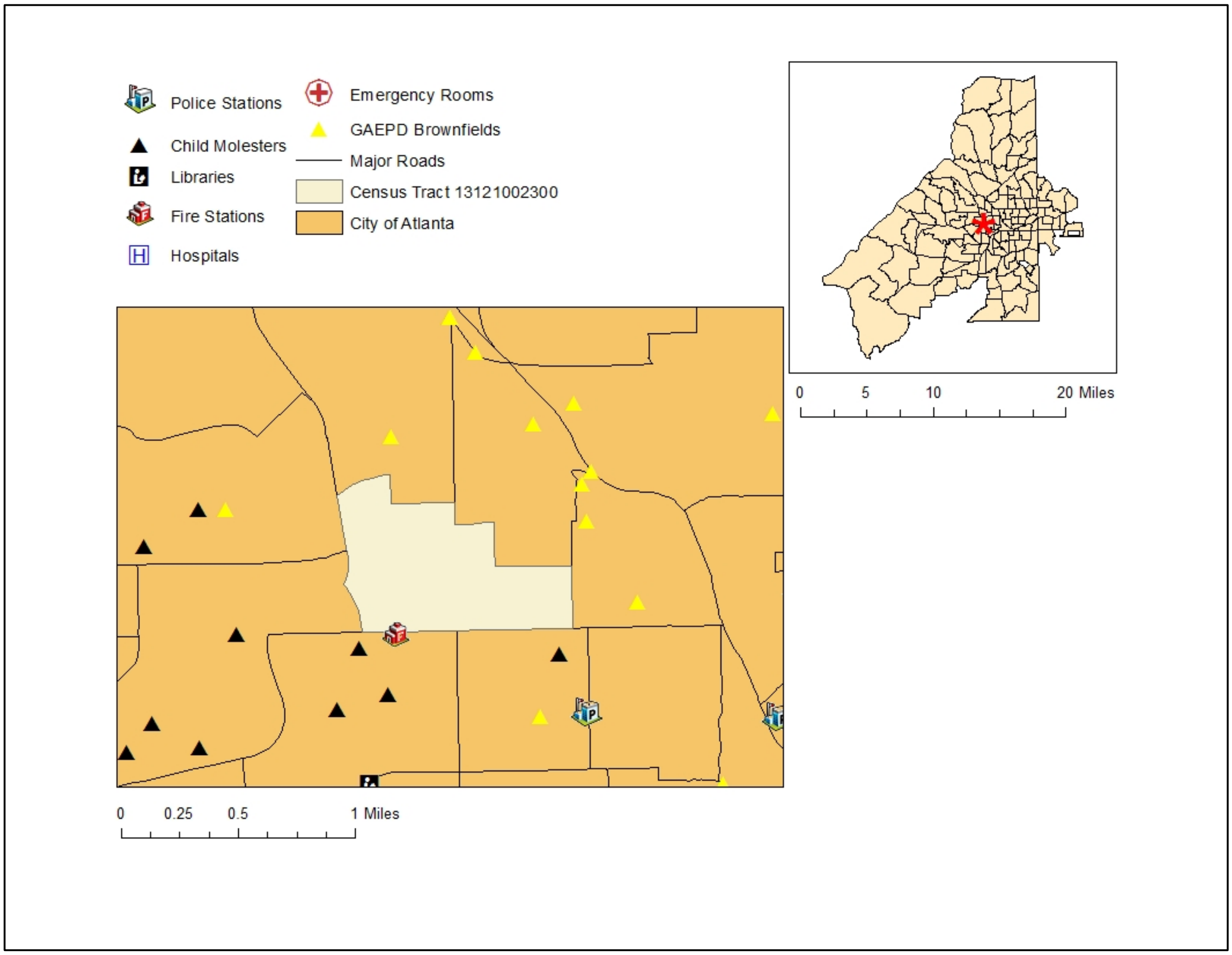

Figure 57 Census Tract 13121002300 Map with Point Locations

5.2 Study Limitations

One limitation of this project is the completeness of the representative datasets. For example, the GAEPD list does not have all brownfields or vacant properties on their list. They only include properties that participate in their program or hazardous sites. Another example is the list of registered sexual offenders which has numerous entries of persons with address unknown currently; therefore this dataset cannot accurately reflect the entire population of registered offenders.

The five minute travel threshold is rather subjective in this study. The buffers generated around police and fire stations can be based on different distance traveled times. For example, emergency vehicles have the right of way in traffic allowing for their time traveled distance to vary highly. Other influences can be presented when considering travel time and distance, such as drivers that do not respond to the hazard signal from emergency vehicles and do not position their vehicle to allow for passage of the emergency responders; the result is an inflated response time. Other delays could result from maintenance or repair to the roads. Hospitals and emergency rooms, individuals are often willing to travel greater distances in order to receive higher quality of health car.

6 CONCLUSION AND FUTURE RECOMMENDATION

6.1 Conclusion

Quality of Life is very important because time spent in life should be enjoyable, but is immensely hard to measure even in general trends. Urban Health Indexes were used in an attempt to gain a better understanding of the general trend in quality of life for the City of Atlanta. UHIv7 showed the center of the city with the lower values and the upper portions of the city to have the higher UHI values. UHIv6 was very different than UHIv7; the better UHI values are found towards the center of the city and most of the outer edges held the lower UHI values. UHIv4 was very similar to UHIv6; the higher UHI values were still seen in the center of the city but with a slightly larger out reach. Extremes of each UHIs upper and lower ten deciles were reviewed for similarities and differences. Several individual census tracts were further studied to gain a more detailed knowledge of the area to evaluate the disparities in quality of life trends.

6.2 Future Recommendations

As we seek to further explore our environment through public health, geographic, and statistical measures more and more variables can always be added. Much of the future recommendations involve integrating more variables. One recommendation is the addition of the crime dataset. Another point that could be adjusted is the size of the network analyst service areas time and distance determinant. Information would inform the public policy makers to reduce the disparities in the quality of life in Atlanta.

REFERENCES

Abercrombie, L. C., J. F. Sallis, et al. (2008). "Income and racial disparities in access to public parks and private recreation facilities." American Journal of Preventive Medicine 34(1): 9-15.

Accordino, J. and G. T. Johnson (2000). "Addressing the vacant and abandoned property problem." Journal of Urban Affairs 22(3): 301-315.

Ackerman, A. R., A. J. Harris, et al. (2011). "Who are the people in your neighborhood? A descriptive analysis of individuals on public sex offender registries." International Journal of Law and Psychiatry 34(3): 149-159.

Adelaja, S., J. Shaw, et al. (2010). "Renewable energy potential on brownfield sites: A case study of Michigan." Energy Policy 38(11): 7021-7030.

Atlangta Police Deparrtment (APD) (2012). "APD Crime Data Downloads." Available at: http://www.atlantapd.org/crimedatadownloads.aspx. Accessed on August 24, 2012.

Atlanta Regional Comission (ARC) (2012). "GIS Data". Available at: http://www.atlantaregional.com/info-center/gis-data-maps/gis-data. Accessed on August 25, 2012.

Baccini, M., A. Biggeri, et al. (2011). "Health Impact Assessment of Fine Particle Pollution at the Regional Level." American Journal of Epidemiology 174(12): 1396-1405.

Baker, E. L., M. A. Potter, et al. (2005). "The public health infrastructure and our nation's health." Annual Review Of Public Health 26: 303-318.

Baumer, E. P., K. T. Wolff, et al. (2012). "A Multicity Neighborhood Analysis of Foreclosure and Crime." Social Science Quarterly 93(3): 577-601.

Brown, T. and G. Moon (2012). "Geography and global health." Geographical Journal 178: 13-17.

Burchfield, K. B. and W. Mingus (2008). "Not in my neighborhood - Assessing registered sex offenders' experiences with local social capital and social control." Criminal Justice and Behavior 35(3): 356-374.

Carse, A. (2011). "Assessment of transport quality of life as an alternative transport appraisal technique." Journal of Transport Geography 19(5): 1037-1045.

Celinska, K. and J. A. Siegel (2010). "Mothers in Trouble: Coping With Actual or Pending Separation From Children due to Incarceration." Prison Journal 90(4): 447-474.

Centers for Disease Control and Prevention (CDC ONE). 2012. "CDC – Concept – HRQOL". Available at: http://www.cdc.gov/hrqol/concept.htm. Accessed on February 13, 2012.

Centers for Disease Control and Prevention (CDC TWO). 2011. "Factsheet.pdf". Available at : http://www.cdc.gov/minorityhealth/reports/CHDIR11/FactSheet.pdf. Accessed on October 31, 2012.

Chen, Y., K. W. Hipel, et al. (2009). "A strategic classification support system for brownfield redevelopment." Environmental Modelling & Software 24(5): 647-654.

Chen, Y., J. Yu, et al. (2010). "Spatial sensitivity analysis of multi-criteria weights in GIS-based land suitability evaluation." Environmental Modelling & Software 25(12): 1582-1591.

Christian, H., B. Giles-Corti, et al. (2011). "The influence of the built environment, social environment and health behaviors on body mass index. Results from RESIDE." Preventive Medicine 53(1–2): 57-60.

Craun, S. W. (2010). "Evaluating Awareness of Registered Sex Offenders in the Neighborhood." Crime & Delinquency 56(3): 414-435.

Dai, D. (2011). "Racial/ethnic and socioeconomic disparities in urban green space accessibility: Where to intervene?" Landscape and Urban Planning 102(4): 234-244.

David, M. (2012). "Demographic determinants of daily travel demand." Transport Policy 21: 20-25.

Dhondt, S., C. Beckx, et al. (2012). "Health impact assessment of air pollution using a dynamic exposure profile: Implications for exposure and health impact estimates." Environmental Impact Assessment Review 36: 42-51.

Dominici, F., R. D. Peng, et al. (2007). "Particulate air pollution and mortality in the United States: Did the risks change from 1987 to 2000?" American Journal of Epidemiology 166(8): 880-888.

Environmental Systems Research Institute (ESRI). 2012. "What is GIS?". Available at: http://www.esri.com/what-is-gis/index.html. Accessed on June 10, 2012.

Fick, J., H. Soderstrom, et al. (2009). "CONTAMINATION OF SURFACE, GROUND, AND DRINKING WATER FROM PHARMACEUTICAL PRODUCTION." Environmental Toxicology and Chemistry 28(12): 2522-2527.

Flynn, J.D. (2009). "Fire Service Performance Measures." Available at: http://www.nfpa.org/assets/files/pdf/os.fsperformancemeasures.pdf. Accessed oon October 30, 2012.

Geller, A., I. Garfinkel, et al. (2009). "Parental Incarceration and Child Well-Being: Implications for Urban Families." Social Science Quarterly 90(5): 1186-1202.

Georgia Environmental Protection Division (GAEPD ONE). "Hazardous Site Inventory". Available at: http://www.gaepd.org/Documents/hazsiteinv.html. Accessed on September 15, 2012.

Georgia Environmental Protection Division (GAEPD TWO). "Hazardous Site Inventory". Available at: http://www.gaepd.org/Files_PDF/outreach/BFList.pdf. Accessed on September 15, 2012.

Glaeser, E. L. (2012). "The challenge of urban policy." Journal of Policy Analysis and Management 31(1): 111-122.

Griffiths, C., H. Klemick, et al. (2012). "U.S. Environmental Protection Agency Valuation of Surface Water Quality Improvements." Review of Environmental Economics and Policy 6(1): 130-+.

Grubesic, T. H. (2010). "Sex offender clusters." Applied Geography 30(1): 2-18.

Grubesic, T. H., E. Mack, et al. (2007). "Geographic exclusion - Spatial analysis for evaluating the implications of Megan's law." Social Science Computer Review 25(2): 143-162.

Harris, P., B. Harris-Roxas, et al. (2010). "Health Impact Assessment for Urban and Land-use Planning and Policy Development: Lessons from Practice." Planning Practice & Research 25(5): 531-541.

Harvey, D. (2010). The enigma of capital : and the crises of capitalism / David Harvey, Oxford ; New York : Oxford University Press, 2010.

Hascic, I. and W. JunJie (2006). "Land Use and Watershed Health in the United States." Land Economics 82(2): 214-239.

Hollander, J. B. (2010). Principles of brownfield regeneration : cleanup, design, and reuse of derelict land. Washington :, Island Press.

Hula, R. C. and R. Bromley-Trujillo (2010). "Cleaning Up the Mess: Redevelopment of Urban Brownfields." Economic Development Quarterly 24(3): 276-287.

Kernsmith, P. D., S. W. Craun, et al. (2009). "Public attitudes toward sexual offenders and sex offender registration." Journal of Child Sexual Abuse 18(3): 290-301.

Kerr, J., D. Rosenberg, et al. (2012). "The Role of the Built Environment in Healthy Aging: Community Design, Physical Activity, and Health among Older Adults." Journal of Planning Literature 27(1): 43-60.

Kim, D., C. F. Baum, et al. (2011). "The contextual effects of social capital on health: A cross-national instrumental variable analysis." Social science & medicine (1982) 73(12): 1689-1697.

Kuper, A., L. Lingard, et al. (2008). "Critically appraising qualitative research." BMJ (British Medical Journal) 337(8): a1035.

Latkin, C. A. and A. D. Curry (2003). "Stressful neighborhoods and depression: A prospective study of the impact of neighborhood disorder." Journal of Health and Social Behavior 44(1): 34-44.

Lee, S. (2011). "Analyzing intra-metropolitan poverty differentiation: causes and consequences of poverty expansion to suburbs in the metropolitan Atlanta region." Annals of Regional Science 46(1): 37-57.

Lindau, S. T., J. A. Makelarski, et al. (2011). "Building community-engaged health research and discovery infrastructure on the South Side of Chicago: Science in service to community priorities." Preventive Medicine 52(3-4): 200-207.

Lipfert, F. W. and C. J. Murray (2012). "Air pollution and daily mortality: A new approach to an old problem." Atmospheric Environment 55: 467-474.

Lo, A. Y. H. and C. Y. Jim (2010). "Differential community effects on perception and use of urban greenspaces." Cities 27(6): 430-442.

Lopez, R. P. (2009). "Public health, the APHA, and urban renewal." American journal of public health 99(9): 1603-1611.

Maclennan, C. F., T. S. Ghosh, et al. (2012). "Derby District Redevelopment in Colorado: Case Study on the Health Impact Assessment Process." Journal of Environmental Health 75(1): 8-13.

Massoglia, M. (2008). "Incarceration, health, and racial disparities in health." Law & Society Review 42(2): 275-306.

Mathie, A. and G. Cunningham (2005). "Who is driving development? Reflections on the transformative potential of asset-based community development." Canadian Journal of Development Studies-Revue Canadienne D Etudes Du Developpement 26(1): 175-187.

Mennis, J., P. W. Harris, et al. (2011). "The Effect of Neighborhood Characteristics and Spatial Spillover on Urban Juvenile Delinquency and Recidivism." Professional Geographer 63(2): 174-192.

Murray, J. and D. P. Farrington (2008). The effects of parental imprisonment on children. Crime and Justice: A Review of Research, Vol 37. M. Tonry. Chicago, Univ Chicago Press. 37: 133-206.

Nagengast, A., C. Hendrickson, et al. (2011). "Commuting from U.S. Brownfield and Greenfield Residential Development Neighborhoods." Journal of Urban Planning & Development 137(3): 298-304.

Ötleş, S. and Ö. Çağındı (2010). "Health importance of arsenic in drinking water and food." Environmental Geochemistry and Health 32(4): 367-371.

Pan, R. J., D. Littlefield, et al. (2005). "Building healthier communities for children and families: Applying asset-based community development to community pediatrics." Pediatrics 115(4): 1185-1187.

Pearsall, H. (2010). "From brown to green? Assessing social vulnerability to environmental gentrification in New York City." Environment and Planning C-Government and Policy 28(5): 872-886.

Ross, C. L., K. L. de Nie, et al. (2012). "Health Impact Assessment of the Atlanta BeltLine." American Journal of Preventive Medicine 42(3): 203-213.

Rothenberg, R., C. Stauber, et al. (2011). "An Urban Health and Health Equity Index (UHI): problems, pitfalls, and potential". Report, World Health Organization Centre for Health Development (Kobe Center), Institute of Public Health and Department of Geosciences, Georgia State University, Atlanta.

Rothenberg, R., S.Weaver, et al. (2012). "FINAL REPORT: Development of an Urban Health Index". Report, Institute of Public Health and Department of Geosciences, Georgia State University, Atlanta.

Ryker, S. J. (2003). Arsenic in ground water used for drinking water in the United States. Arseind in Ground Water, Geochemistry and Occurance. A. H. Welch, Stollenwerk, Kenneth G. Norwell, Kluwer Academic Publishers: 165-178.

Saginor, J. D. (2011). "Principles of Brownfield Regeneration: Cleanup, Design, and Reuse of Derelict Land." Journal of Planning Education and Research 31(2): 229-231.

Seaman, P. J., R. Jones, et al. (2010). "It's not just about the park, it's about integration too: why people choose to use or not use urban greenspaces." International Journal of Behavioral Nutrition and Physical Activity 7.

Setton, E. M., C. P. Keller, et al. (2008). "Spatial variations in estimated chronic exposure to traffic-related air pollution in working populations: A simulation." International journal of health geographics 7.

Stucky, T. D., J. R. Ottensmann, et al. (2012). "The Effect of Foreclosures on Crime in Indianapolis, 2003-2008." Social Science Quarterly 93(3): 602-624.

Tappendorf, J. A. and B. O. Denzin (2011). "Turning Vacant Properties into Community Assets Through Land Banking." Urban Lawyer 43(3): 801-812.

Thomas, M. R. (2002). "A GIS-based decision support system for brownfield redevelopment." Landscape and Urban Planning 58(1): 7-23.

Turnock, B. J. (2004). Public health : what it is and how it works / Bernard J. Turnock, Sudbury, Mass. : Jones and Bartlett, c2004. 3rd ed.

United States Environamnetal Protection Division (USEPA ONE). "Drinking Water from Household Wells. Retrieved Well Water Quality". Available at: http://water.epa.gov/drink/info/well/upload/2003_06_03_privatewells_pdfs_household_wells.pdf. Accessed on Feburary 22, 2012.

United States Environmental Protection Agency (USEPA TWO). “Basic Information | Brownfields and Land Revitalization | US EPA”. Available at: http://www.epa.gov/brownfields/basic_info.htm#plan. Accessed on February 14, 2012.

Walsh, P. J., J. W. Milon, et al. (2011). "The Spatial Extent of Water Quality Benefits in Urban Housing Markets." Land Economics 87(4): 628-644.

Wang, L. Z., L. P. Fang, et al. (2011). "Negotiation over Costs and Benefits in Brownfield Redevelopment." Group Decision and Negotiation 20(4): 509-524.

Wedding, G. C. and D. Crawford-Brown (2007). "Measuring site-level success in brownfield redevelopments: A focus on sustainability and green building." Journal of Environmental Management 85(2): 483-495.