

Zoning's Connection with Racial Distribution

A Case Study on the Washington, D.C. MSA

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Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

MASTER OF
URBAN AND REGIONAL PLANNING

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VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

March 29, 2007
Blacksburg, VA

Keywords: zoning, racial distribution, minority housing, Census GIS, affordable housing

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(ABSTRACT)

Zoning, as a public land-use tool, has several important goals. As zoning accomplishes these goals, however, zoning has had the unintended outcome of guiding high numbers of minorities into certain areas in which multi-family housing is permitted. This study attempts to understand the connection that zoning has with racial and ethnic distribution within and across jurisdictions in the Washington, D.C. MSA.

By using GIS to spatially connect zoning districts to Census data, I analyzed correlations between minority populations and zoning district regulations. For all locations studied, I found that proportions of minority population generally increase as zoning districts permit higher-intensity residential uses. Minority populations often increased as the density permitted by zoning districts increased, although there were many exceptions to this trend, most notably in the central city where minority populations did not directly correlate with zoning density. In all cases, however, low-density, single-family zoning districts had higher white populations than other, higher-density zoning districts. Zoning was shown to have the greatest correlation with minority populations in jurisdictions undergoing significant population growth, particularly minority population growth.

The study shows that racially-segregated neighborhoods exist across a variety of zoning types, including low-density, single-family districts, but that segregation is more abundant within zoning districts that permit higher-intensity uses and higher-densities. White isolation was found to be greatest in low-density, single-family zoning districts.

Although there is a clear connection between zoning regulations and minority population settlement, zoning density does not perfectly correlate with minority population and racially-segregated areas. Many higher-density zoning districts throughout the study area have high white populations and high levels of white clustering. Conversely, high minority populations and minority clustering occur to significant extents in parts of single-family zoning districts, particularly in Washington and Prince George's County.

ACKNOWLEDGMENTS

As I progressed through this research project, I have received significant assistance from a number of people. I would like to thank each member of my committee for providing considerable feedback in my writing process and for contributing to my academic and professional development here at Virginia Tech.

First, I would like to thank my committee chair, Casey Dawkins. Dr. Dawkins has been an instrumental part of this research project. He helped me design this research project and has assisted me throughout my research, writing and revision processes. Furthermore, Dr. Dawkins has been very influential in the rest of my academic development. I learned several research techniques in both of Dr. Dawkins' quantitative methods classes. I have also expanded my planning knowledge in his urban growth management class.

Diane Zahm's courses contributed to much of my professional development during my studies at Virginia Tech. Her planning studio and land use planning courses enabled me to be involved with local planning projects and gain professional planning experience. She has also provided valuable assistance in this research project, particularly in the revision process.

Stephen Prisley has also provided valuable feedback in my research process. He helped me refine my GIS methodology for this project. His GIS course greatly expanded my GIS capabilities, enabling me to complete this research project and giving me skills that will be invaluable as an urban planner.

Additionally, several other members of the Virginia Tech faculty have contributed to my academic and professional development. I would like to thank Lisa Schweitzer, John Browder, John Levy, Ted Koebel, Antoine Hobeika, Paul Knox and Earthea Nance.

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CHAPTER 1: INTRODUCTION

Over the next 25 years, the United States can expect to see over 45 million new housing units built (De Souza Briggs, 2005). Nelson (2004) estimates that about half of all housing units in 2030 will have been built after 2000. Many of these units will have replaced older, decaying housing units, while many other units will have accommodated the needs of a growing and transient population. Much of the nation's growing population will continue to be from a racial or ethnic minority group.

During the 1990s, minority groups constituted 80% of the country's population growth (De Souza Briggs, 2005). Minorities also constituted a majority of suburban population growth in major metropolitan areas in the 1990s (Frey, 2001). Historically, large numbers of minorities have been subjected to highly-segregated neighborhoods; however, as the urban and suburban minority population grows, and as new housing units are built, localities have the opportunity to encourage more racial integration. Municipal zoning regulations and other local land-use controls are going to play a major role in shaping both the character of these new housing units and the population residing in them.

As zoning has accomplished its goals of improving public health, safety, morals and general welfare, it has also had two possible unintended consequences. The first of these consequences has to do with zoning's impact on urban racial distributions. A wide array of literature confirms that zoning has contributed to the uneven racial and ethnic distribution prevalent in metropolitan areas in the United States (Pendall, 2000; King, 1978). Minorities and the low-income population are more commonly dependent on rental, multi-family and affordable housing units (Pendall, 2000) – 9% of owner-occupied householders are black, for example, while about 20% of renter-occupied householders are black (Census, 2005). Thus, zoning regulations that impose limitations on the location of new housing types can discourage low-income and minority settlement in certain areas. This study examines connections between the spatial orientation of zoning districts and racial and ethnic distribution and segregation within and across five jurisdictions in the Washington, D.C. MSA.

To determine zoning's correlation with minority populations in each of these locations, I begin by examining minority populations across zoning type and zoning density. For each of the jurisdictions in this study, I analyze the racial composition of each zoning district through a series of maps, tables and charts.

Segregation is analyzed through a series of histograms that analyze the distribution of Census blocks high in minority population and blocks high in white population. These charts will help clarify the evenness of the distribution of whites and minorities within particular zoning districts and types of zoning districts. To further examine segregation patterns, I conduct a series of segregation indices for Washington and Alexandria. These indices include the dissimilarity index, the interaction index, the isolation index, the delta index and Theil's index.

The second possible unintended consequence of zoning is its impact on income distribution. There has been evidence that income segregation is occurring to a greater extent than racial segregation (Jargowsky, 1996; Fischer et al., 2004). Zoning can affect affordable housing supply, which can impact the settlement patterns of low-income households. To examine zoning's correlation with different income classes, I analyze each jurisdiction's income distribution by zoning district.

To validate my findings, I analyze the housing stock within each zoning district to verify that the housing types in each zoning district are representative of the density and housing types permitted within each zoning district. Although housing availability may be consistent with zoning regulations, it does not necessarily imply that zoning is responsible for determining the type of housing available in each area. In many instances, such as in Washington, D.C., housing was established before zoning regulations; zoning regulations were merely designed on the type of housing established in each area. In other instances, changing market conditions and new housing construction could result in many zoning changes. .

The remainder of this report is broken into eight additional chapters. Chapter 2 provides background information corresponding to my study. In this chapter, I briefly discuss the history of zoning and its original goals. Then, I examine some of the unintended outcomes of zoning, focusing on zoning's contribution in shaping the spatial orientation of different population groups. This chapter continues by detailing the pertinence of the Washington, D.C. MSA for this study and giving an in-depth look at the population dynamics of my study area. Chapter 3 explains the approaches used to analyze zoning's connection to racial segregation in various locations within the Washington, D.C. MSA. In chapters 4 through 8, I provide the results of my research for each jurisdiction included in this study. Chapter 4 provides detailed results for Washington, D.C. Chapter 5 gives my findings for Alexandria, Virginia. Chapter 6 looks at Frederick, Maryland, while Chapter 7 provides results for Montgomery County and Prince

George's County, Maryland. Chapter 8 consists of a cross-jurisdictional comparison of the various entities comprising my study area. This comparison examines connections between the racial compositions of each locality and the amount of land that each locality designates to certain types of residential zoning. I conclude with chapter 9. In addition to concluding remarks and a summary of the report's findings, I will discuss potential approaches to reduce land-use regulations' effects on racial segregation. I will also analyze my research process and discuss possibilities for further research.

CHAPTER 2: BACKGROUND

HISTORY OF ZONING

Zoning has been the predominant land-use planning tool used in the United States since its inception early in the twentieth century. New York City established the nation's first zoning ordinance in 1916. Ten years later, the Supreme Court upheld zoning in *Euclid v. Ambler Realty*. In this case, the Supreme Court upheld the Village of Euclid's zoning ordinance, giving communities the right to separate residential land from more intense land uses. Even before the Euclid case, nearly 500 communities were already using zoning (Gitelman et Al., 1997). The Standard Zoning Enabling Act (1926) gave states a model with which they could enable localities to adopt zoning regulations, and most states quickly used this model to enable zoning (Gitelman et Al., 1997).

Zoning spread quickly because it was perceived as a necessary planning tool during the early 20th century. During this time period, cities suffered from a number of severe urban problems that resulted in large part from extreme population densities. Cities in the early 1900s were prone to many problems such as poor infrastructure, disease and fire. Planning tools in this period, including zoning, were designed to eliminate or at least reduce many of the problems resulting from overcrowding. The Standard Zoning Enabling Act (1926) stated many of the purposes of zoning. The primary purposes of zoning are to promote the "health, safety, morals, or the general welfare of the community". Zoning was designed to do this by establishing land-use regulations that would reduce congestion and overcrowding, provide a more open environment with better access to light and air, and create a built environment less prone to the spread of fire. To accomplish these goals, zoning typically enacts regulations that separate land by use, establish maximum densities of housing or other buildings, enforce minimum setbacks of buildings from property lines, and limit buildings to a maximum height. Considering the severity of congestion, overcrowding and the corresponding issues in large urban areas such as New York City, it is not surprising that cities were quick to adopt zoning ordinances in the early twentieth century.

Rather than simply being a land use regulation acting on its own to achieve these goals, zoning achieves these goals based on conformance with comprehensive plans. Most states' enabling legislation require zoning to be made in accordance with a comprehensive plan.

Comprehensive planning aims to maximize public welfare as deemed appropriate by the residents of the locality. By associating zoning with comprehensive planning, localities attempt to assure that their land use regulations best enhance local public welfare (Gitelman et Al., 1997).

Zoning as a planning tool has achieved many of its goals. Despite rapid population growth throughout the twentieth century, most modern cities have fewer problems resulting from overcrowding. By separating uses, particularly residential uses from industrial and other high-intensity uses, zoning has encouraged healthier living environments. Density limits and minimum lot sizes requirements have limited overcrowding in urban areas. Setback requirements have resulted in more space between buildings, which has produced an urban environment less conducive to the spread of fire. Height limitations, maximum lot coverages and setback requirements have opened up the urban environment, giving residents better access to air and sunlight.

ZONING'S UNINTENDED OUTCOMES

Although zoning has been successful in transforming the urban environment to promote healthier and less crowded living conditions, zoning has had several unintended consequences. By separating uses and requiring low densities and large lot sizes in many areas, zoning regulations often coincide with low-density urban environments that are largely dependent on the automobile (Sheller and Urry, 2000). Land that is separated by use can create hardships for people attempting to walk from their homes to shopping or employment centers. The low-density nature of many urban areas makes transit less feasible. As a result, more of the population must rely on automobile travel. The necessity to use cars as a means of transportation can demand a large portion of a household's income, particularly low-income households (Flint, 2006).

Zoning has also had the unintended consequence of guiding different populations into different areas. Zoning can affect the socioeconomic composition of different areas within municipalities (Shlay and Rossi, 1981). Since zoning separates residential areas into different densities and different single-family or multi-family use designations, zoning can have a strong influence on the type and affordability of housing available in certain areas. This separation of housing can influence the separation of certain populations based on different housing needs.

The minority population is one group that has been significantly affected by zoning's regulations on the location of housing types and densities. This phenomenon has to do with the fact that minorities have somewhat different housing needs than whites. Rosenbaum (1994) describes minority housing consumption as being dominated by lower quality, lower cost housing units. Consequently, land use regulations affecting housing availability and affordability can impact minority settlement patterns.

The primary differences in minority housing needs stem from housing cost and housing tenure. First, minorities have lower home-ownership rates than whites. Jackman and Jackman (1980) found that blacks have a much lower probability of owning a home than whites with similar socio-economic characteristics. A study by Krivo (1986) confirms that Hispanics are also less likely to own their homes than whites. Rosenbaum's (1996) findings confirm that, controlling for income and other household characteristics, all minority groups exhibit lower home-ownership rates than whites. Blacks and Hispanics generally have more difficulties in establishing the credit needed to acquire a loan to purchase a home. Their lower incomes also make it difficult for minority households to save enough money to make a down payment toward the purchase of a residential unit. As a result, minorities more commonly rent housing than whites.

A second difference in minority housing needs is that minorities depend on lower-cost housing units than whites. Median minority (other than Asians) incomes throughout the nation are substantially lower than median white incomes. In 2005, the non-Hispanic white median household income was \$50,622, while the black and Hispanic median incomes were \$30,939 and \$36,278, respectively (Census, 2005). This income difference makes it difficult for most minorities to afford the same level of housing as whites. Rosenbaum (1996) found that blacks and Hispanics are less likely than whites with similar household characteristics to reside in high-quality housing units. Furthermore, Jackman and Jackman (1980) found that when controlling for socio-economic status, homes that are owned by minorities tend to be of considerably less value than homes owned by whites. The reliance on affordable housing, however, is much more considerable among low and moderate-income minorities. Minorities with higher incomes will not be as affected by a shortage of low-cost housing in certain areas. Thus, zoning and land-use controls will primarily affect the settlement patterns of low-income minorities and have less of an impact on the more affluent minority population.

These differences in housing needs between minorities and whites result in land-use controls having different levels of impact on these different population groups. Land-use regulations such as zoning that restrict housing type and density can lead to fewer rental units (Pendall, 2000). A shortage of rental units excludes low-income minorities in three ways. First, fewer rental units in an area means that a fewer number of minorities will be able to find adequate housing in this area. Second, a shortage of rental supply can drive up the price of existing rental units, making it difficult for minorities to afford these units. Third, rental supply shortages allow landlords to be more selective in choosing tenants. Racial and ethnic discrimination has often resulted in these landlords selecting white tenants (Pendall, 2000).

Since rental housing is much less prevalent in single-family zoning districts, an abundance of single-family districts that prohibit any multi-family housing can prevent minority settlement. Pendall (2000) found that municipalities that permit only low-density development have lower proportions of minorities than jurisdictions that permit higher-density, multi-family uses¹.

In several cases, zoning's influence on housing has contributed to widespread racial segregation. In addition to the influence zoning can have, segregation has historically been caused by a number of other factors as well such as housing discrimination, differing household characteristics, and racial preferences (Bayer et Al. 2001; Bayer et Al. 2003; Reibel, 2000; Yinger, 1986; Clark, 1992). Throughout zoning's history, several communities have designated their residential land as only permitting low-density, residential developments (Pendall, 2006; King, 1978). In these localities, the result has been more land consumption per housing unit, more expensive infrastructure, and generally higher-priced housing (Stockman, 1992). By assuring larger and more expensive lots, these communities reduced the likelihood of low-income minorities being able to locate in these areas. Rather, low-income minorities have clustered in central cities and inner suburbs that have offered a wider variety of housing types.

This impact that zoning can have on the minority population has several negative outcomes. By guiding the minority population into certain areas designated for multi-family use, much of the minority population will be unable to locate near employment opportunities. This

¹ In addition to land-use control variables, Pendall's regression model controls for various housing and household variables such as structure type, occupancy status, tenure, race, and educational attainment.

spatial mismatch results in long and expensive commutes to work. Due to the decentralization of employment, this spatial mismatch can also reduce the likelihood of central city minorities being aware of a wide array of employment opportunities (Martin, 2001).

When zoning plays a part in influencing minorities to locate in racially segregated areas, minorities experience even more negatives as a result. First, being located in segregated neighborhoods cuts off large numbers of minorities from social networks with the larger and often times more affluent population. Removing these social ties can further hinder economic opportunities for minorities. Also, when widespread segregation occurs with certain jurisdictions containing high amounts of low-income minorities and other jurisdictions containing a much more affluent population, these low-income minorities are held to a fiscal disadvantage. Differences in racial composition between jurisdictions often results in minorities living in municipalities with a much lower tax base. This low tax base results in minorities receiving lower quality public services such as school and police service (Abramson, et. al., 1995).

Through an analysis of zoning's connection with racial distribution, my study analyzes zoning's unintended outcome of facilitating different types of populations in different areas. Equitable land-use tools should not facilitate high levels of minority population in certain areas while discouraging the settlement of minorities in other areas. By doing so, zoning prevents these populations from locating where they otherwise would have located, often resulting in longer commutes to jobs. Each locality in my study area has a significant portion of land set aside for low-density residential development and other areas designated for higher-density residential development. These different land-use regulations covering different areas of each locality could be facilitating an inequitable distribution of whites and minorities within each locality and accommodating high levels of segregation within these jurisdictions.

RESEARCH QUESTIONS AND EXPECTATIONS

This study analyzes the correlation between municipalities' zoning districts and their racial/ ethnic distribution. This research project is driven by the following questions:

- To what extent does zoning coincide with the minority population distribution?
- To what extent does zoning type/ zoning density correspond with racially/ ethnically-segregated areas?

- Are the regulations of each zoning district accurately portrayed by the existing housing stock?

Much of the literature has confirmed that zoning has at least some level of contribution to the racial and ethnic segregation patterns existing across modern metropolitan areas. This study aims to show that within jurisdictions, minority populations correlate with zoning density and zoning type.

If zoning has no connection with racial distribution, one would expect the proportion of minorities to be approximately even in each zoning district, regardless of housing density or housing type permitted. This, however, is not likely to be the case because of minority's differing housing needs.

Assuming that zoning has a significant impact on racial and ethnic settlement patterns, one would expect minority populations to be higher in multi-family zoning districts and to increase as zoning districts' permitted densities increase. Since multi-family housing is typically comprised of a larger proportion of rental units than single-family detached housing, minorities can be expected to more commonly reside in multi-family zoning districts. Housing affordability often increases as higher densities are permitted. This affordability would enable higher numbers of minorities to locate in higher-density zoning districts.

If zoning is a factor in determining racial and ethnic distribution, minority proportions should be highest in the highest-density zoning districts and lowest in the lowest-density zoning districts. Racial and ethnic segregation would be primarily confined to high-density, multi-family zoning districts, while low-density, single-family districts would enable the isolation of large numbers of whites. Municipalities that have low minority populations (relative to other municipalities in the same region) should have more land devoted to low-density single-family zoning districts than those municipalities that have high minority populations.

STUDY AREA

In an effort to answer my research questions, I am conducting this research project on various municipalities within the Washington, D.C. metropolitan statistical area (MSA). I chose the Washington, D.C. MSA to serve as my case study for several reasons. First, the D.C. MSA

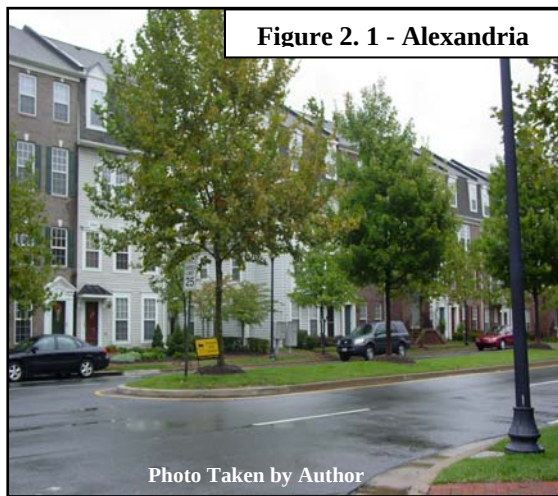
has a large minority population that includes significant black and Hispanic populations. Many MSA's contain large minority populations, but only a few (D.C., New York, Chicago, Los Angeles, and certain MSA's in Texas and Florida) contain significant black and Hispanic populations. Table 2.1 shows the racial/ ethnic composition of the Washington, D.C./ Baltimore CMSA. Due to the rapidly-growing Hispanic population in the nation, this group could serve as an interesting comparison to the black population. Zoning's correlation with the distribution of the two groups could be different since members of the Hispanic population are more likely to have recently settled in their current location, while African-Americans are more likely to have resided in their present location for a longer period. Zoning's connection with recently-settled minorities could be different from zoning's impact on more well-established minorities.

TABLE 2.1 – Washington, D.C. MSA

	Total Population	Percent of Total		
		Black	Hispanic	Minority
Washington, D.C./ Baltimore CMSA	7,608,070	26%	6%	40%

Data Source: U.S. Census 2000

The Washington, D.C. MSA is also one of the nation's largest MSA's and contains various large suburbs that could be interesting to analyze. Many suburbs are near the city, but other suburbs/ exurbs are more distant. In fact there are several municipalities within the MSA that are fairly isolated from the MSA center. These communities could be interesting to study



because they could be representative of zoning's impact on segregation in smaller towns and cities.

Finally, I chose the D.C. MSA because of its proximity to Virginia Tech. This proximity enabled me to visit the metropolitan area to gather a sense of the types and scale of developments that occur in the various zoning districts. Faculty at Virginia Tech's Alexandria campus also helped me acquire necessary zoning data from certain municipalities.

Due to time and data limitations I could not include every municipality within the Washington, D.C. MSA. I was able to gather necessary data and conduct my research on five jurisdictions:

Washington, D.C. (Figure 2.2)

Alexandria, Virginia (Figure 2.1)

Montgomery County, Maryland

Prince George's County, Maryland

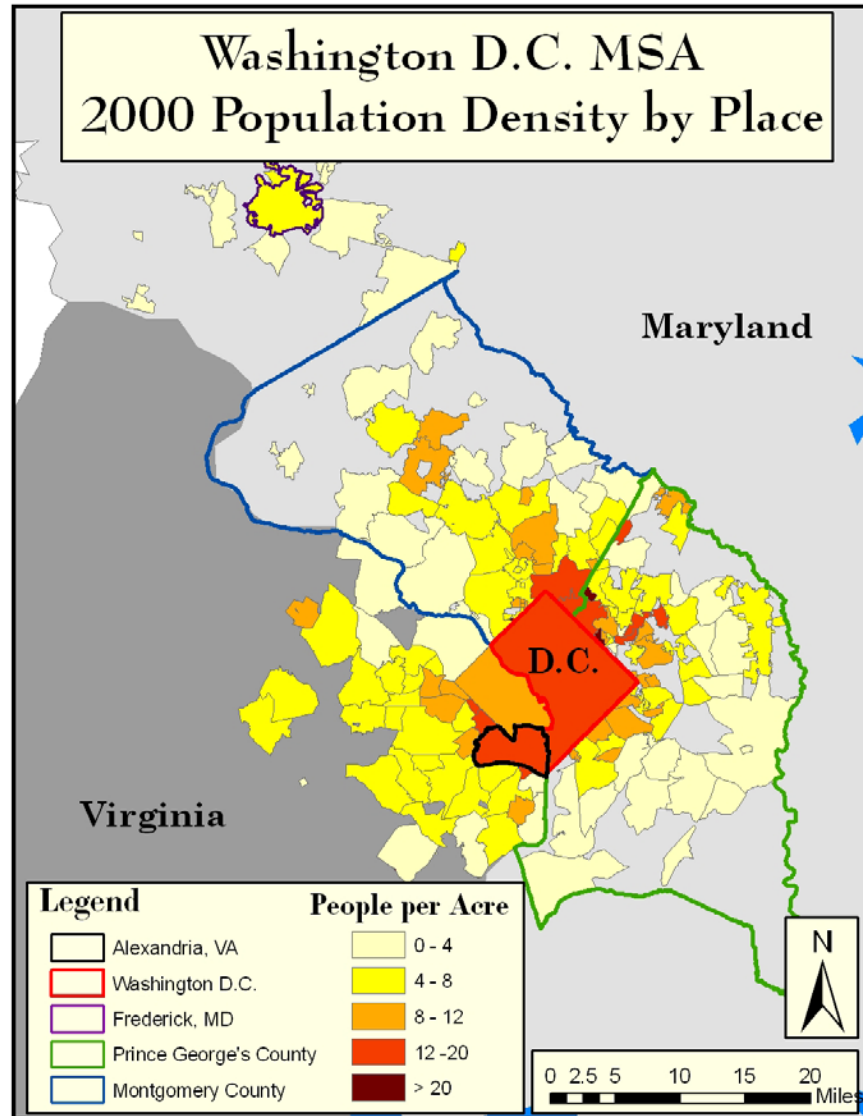
Frederick, Maryland

Although I only included five municipalities in my study, these five municipalities cover a large portion of the MSA and bring a great deal of diversity to my study. Alexandria, Montgomery County and Prince George's County are all adjacent to Washington D.C., while Frederick is fairly isolated from the central

city. These five locations comprise a 1999 population of nearly 2.5 million people, more than half of which belong to a minority (See Table 2.2). Figure 2.3 shows the population distribution of the Washington, D.C. MSA by Census-defined places. Washington, D.C., Alexandria and the other places adjacent to D.C. have the highest population densities. Both Montgomery County and Prince George's County have low-density areas further from D.C. If zoning districts are heavily influencing the population settlement patterns, we would expect low-density zoning in these outlying areas of the two counties and low proportions of minorities in these areas.



FIGURE 2.3



Data Source: US Census 2000

Although Prince George's County and Montgomery County exhibit similar population density patterns and overall populations, the minority populations of the two counties are vastly different. Table 2.2 shows that Prince George's County has more than four times as many black residents and nearly twice as many minority residents as Montgomery County. Washington, D.C. has a similarly high minority population with 60% of the population being black and over 70% belonging to a minority. Alexandria has a smaller minority population than Washington and Prince George's County, but black, Hispanic and overall minority population proportions are slightly higher in Alexandria than in Montgomery County. Alexandria and Montgomery County both have higher Hispanic populations than the other localities within the study area. Frederick

has a much smaller minority population than any other locality within the study area. All localities, however, exhibit some degree of diversity because the largest proportion of any one racial/ ethnic group in any of these places is 75% (non-Hispanic whites in Frederick).

TABLE 2.2 – Study Area Racial/ Ethnic Population

Location	Total Population	Black		Hispanic	
		Population	Percent	Population	Percent
Washington DC	572,059	343,312	60%	44,953	8%
Alexandria, VA	128,283	28,915	23%	18,882	15%
Montgomery County, MD	873,341	132,256	15%	100,604	12%
Prince George's County, MD	801,327	502,540	63%	57,043	7%
Frederick, MD	52,843	7,777	15%	2,533	5%
Totals	2,427,853	1,014,800	42%	224,015	9%

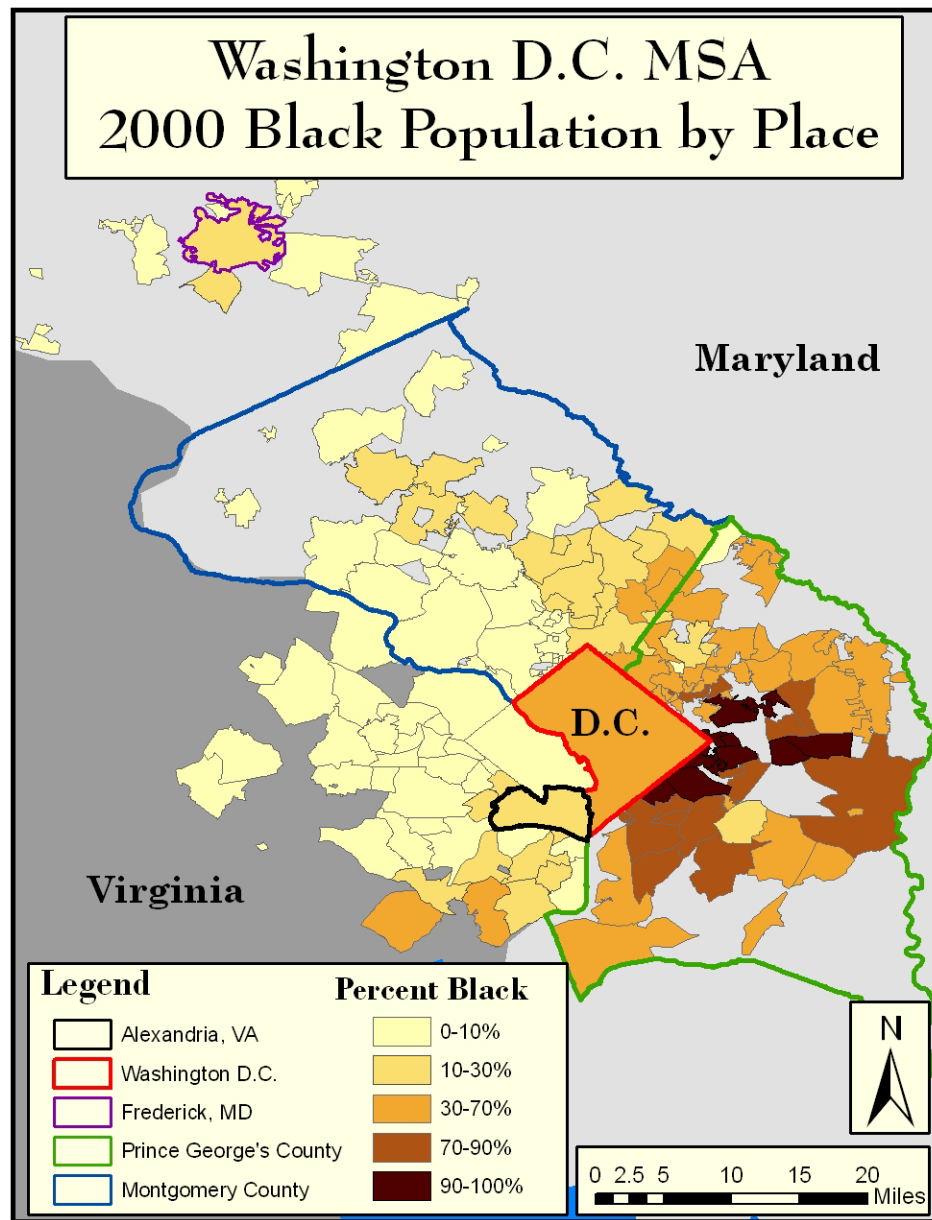
Location	Total Population	White		Minority	
		Population	Percent	Population	Percent
Washington DC	572,059	159,178	28%	412,881	72%
Alexandria, VA	128,283	68,889	54%	59,394	46%
Montgomery County, MD	873,341	519,318	59%	354,023	41%
Prince George's County, MD	801,327	194,683	24%	606,644	76%
Frederick, MD	52,843	39,644	75%	13,199	25%
Totals	2,427,853	981,712	40%	1,446,141	60%

Data Source: U.S. Census 2000

Alexandria, Frederick, and Montgomery County have the lowest minority proportions of the places in this study. If zoning has a major influence on racial distribution, one would expect these municipalities to have less land devoted to high-density zoning districts and more land devoted to single-family zoning districts.

Figure 2.4, 2.5 and 2.6 show the spatial distribution of these places' minority population. Figure 2.4 shows 2000 black population. Prince George's County has high black populations throughout the county. Most of Prince George's County has black populations consistent with or higher than the black population of the central city. Montgomery County, Northern Virginia and Frederick, MD all have substantially lower black populations throughout these regions.

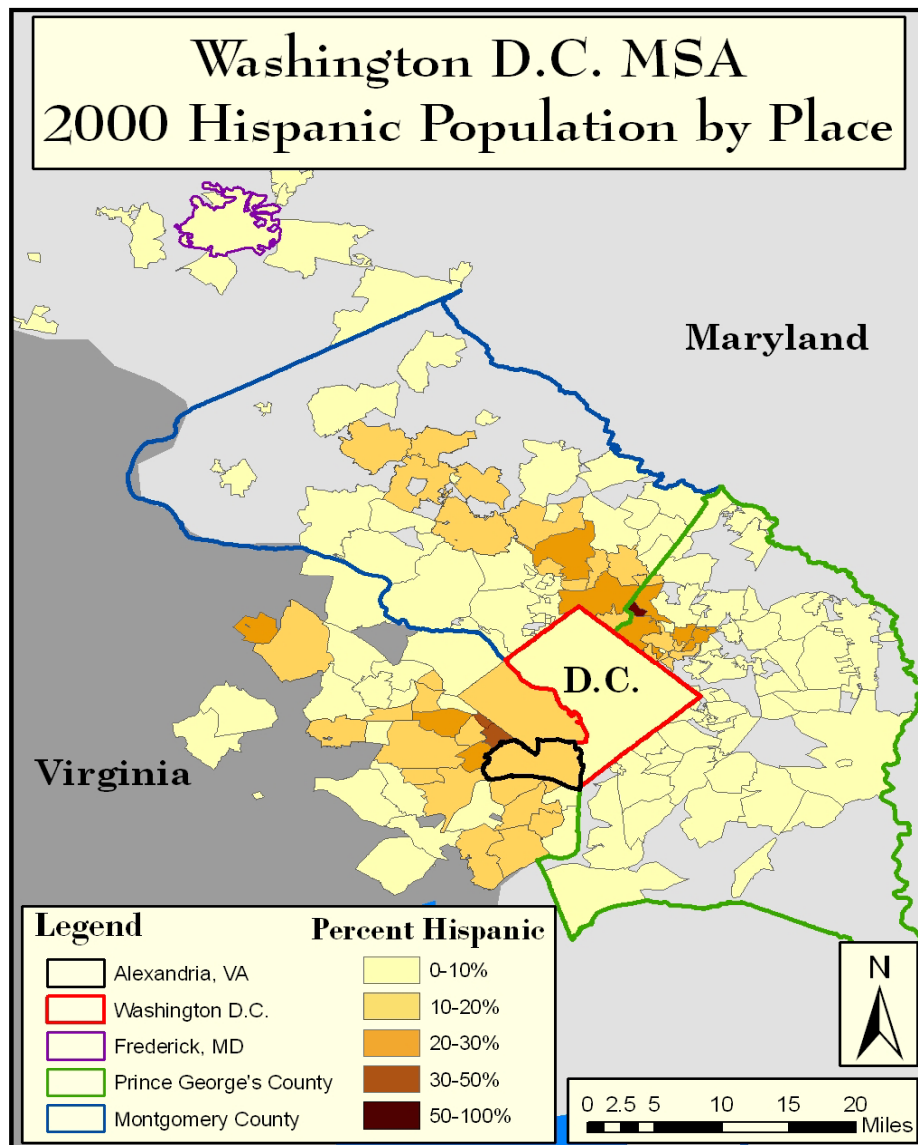
FIGURE 2.4



Data Source: US Census 2000

The MSA's Hispanic population distribution is shown in Figure 2.5. Unlike its large black population, most of Prince George's County has a small Hispanic population. Alexandria and many places within Montgomery County, on the other hand, have much higher Hispanic populations.

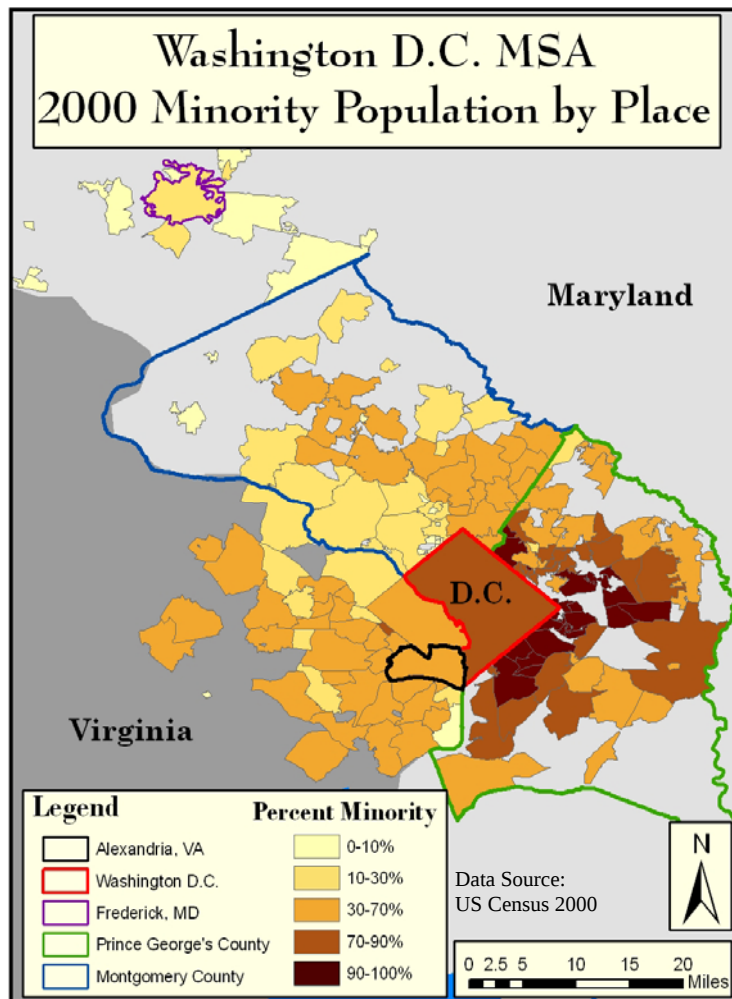
FIGURE 2.5



Data Source: US Census 2000

Overall minority populations, as shown in Figure 2.6, are high throughout most of the MSA. Minority populations, however, are fairly low in Southern Montgomery County and in Frederick. This phenomenon could be explained by historical settlement patterns, racial and ethnic discrimination, household preferences, and/ or land use controls. If zoning plays an important factor in Montgomery County's racial distribution, the county will have more low-density zoned areas along the county's southern edge and more high-density zoned areas along the county's eastern edge.

FIGURE 2.6



Although zoning may indirectly influence the population distribution within and across jurisdictions, zoning's principle impact is on the built environment. Although many older zoning ordinances have played important roles in shaping municipalities' existing built environments, modern zoning ordinances will have the largest impact in areas undergoing considerable new development or intensive redevelopment. Areas experiencing high levels of development are typically going to experience dramatic population growth as well.

Washington, D.C. and many older suburbs are nearly built out,

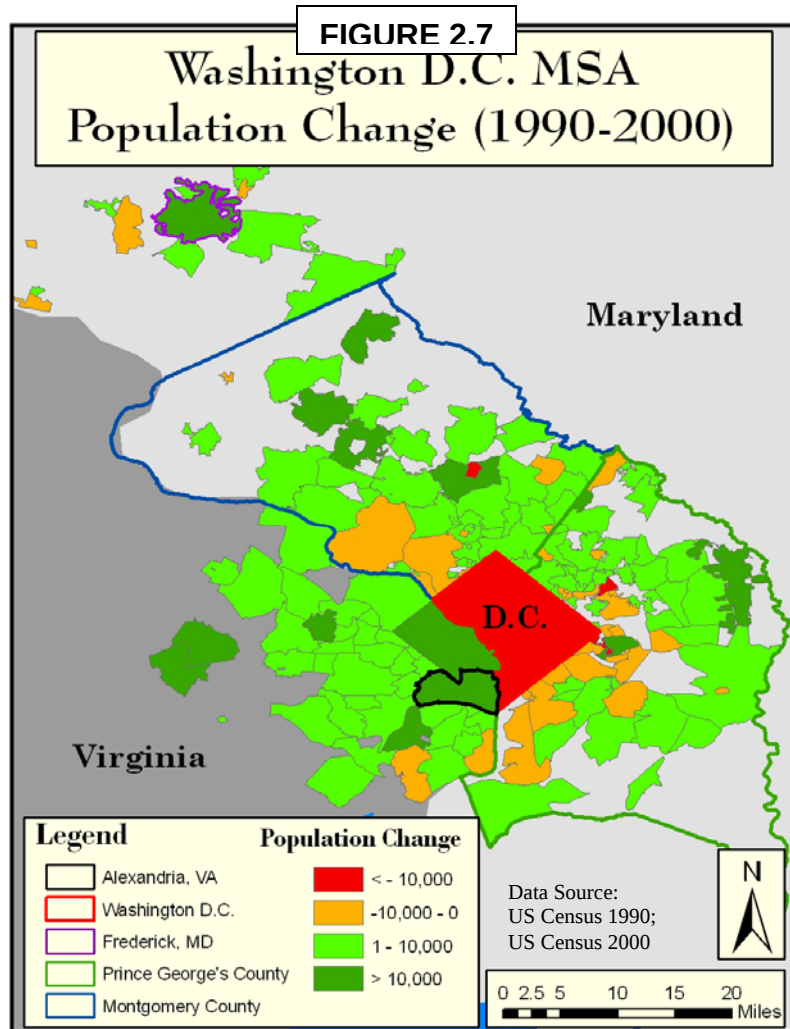
while other places further from the central city have more vacant land available for new developments. Figure 2.7 shows the population changes that occurred from 1990 to 2000. As expected from the availability of vacant land, Washington, D.C. and many inner suburbs experienced negative population growth. The fastest growth has occurred in the suburbs, with many outer suburbs experiencing some of

the highest growth rates. Thus, suburbs are experiencing higher rates of new development than the central city and will be more significantly affected by zoning as it undergoes future development. New housing opportunities and the population relying on this new housing will witness new housing developments shaped by the jurisdiction's zoning framework.

Washington, D.C.'s zoning ordinance, which was first used in 1920, has played a considerable role in shaping the city as it has grown and in preserving the city as it undergoes redevelopment. Zoning in D.C. may not regulate much new development, but its existing built environment was

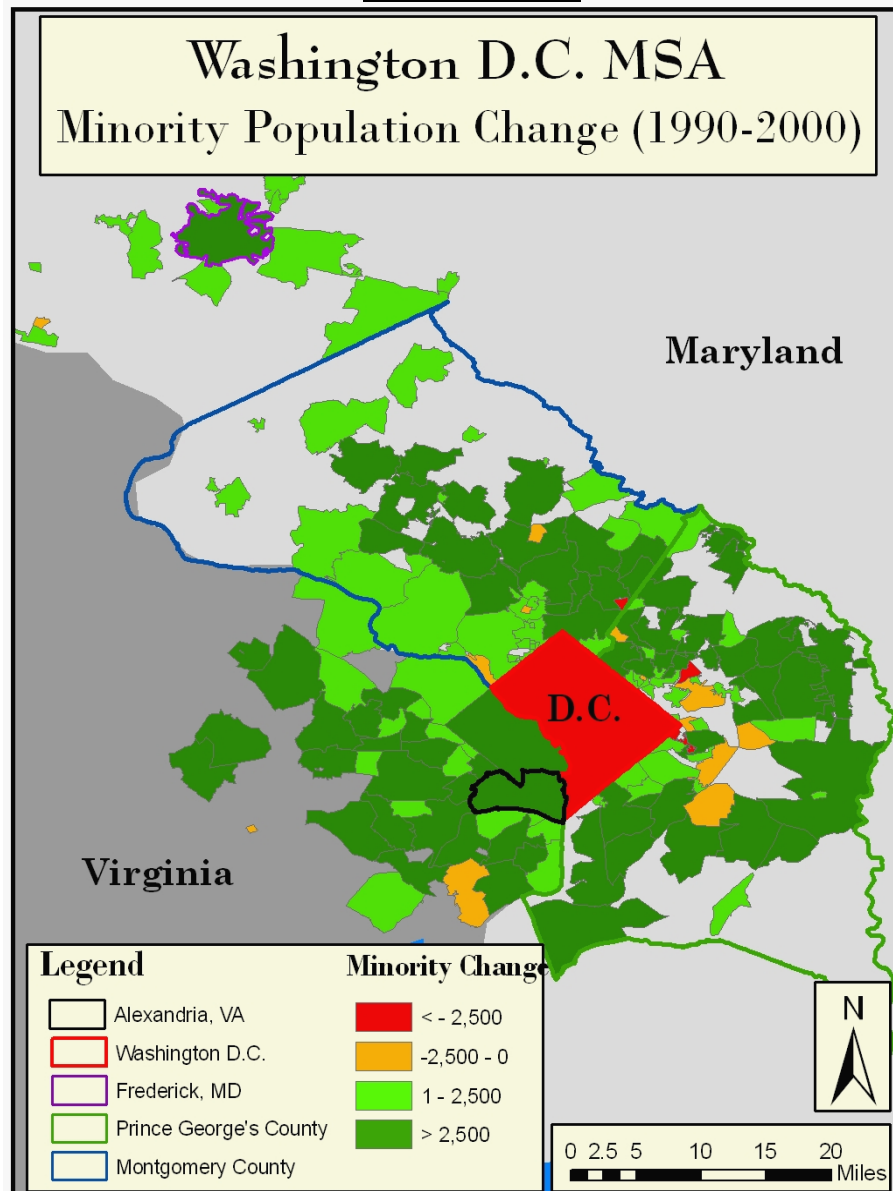
and continues to be influenced by zoning. Thus, the housing opportunities available to the transient population within the city will be in large part determined by Washington's various zoning districts.

Minority population change from 1990-2000 resembles the overall population growth patterns over the same period. Figure 2.8 shows that minority populations declined in the central city and a few suburban places, while the majority of suburbs, including many suburban locations distant from D.C., experienced dramatic minority population growth. Figures 2.9 and 2.10 differentiate the black population changes from the Hispanic population changes, respectively. Black population growth tended to gravitate toward outer Prince George's County, while Hispanic growth occurred in Washington, D.C., Northern Virginia, and Montgomery County. Both blacks and Hispanics dramatically increased in numbers in Frederick. Although



Frederick has the lowest minority proportion of any of the jurisdictions in this study, it is experiencing considerable minority population growth. This growing population suggests that Frederick's zoning ordinance is not necessarily limiting the settlement of the minority population, even though the city has such a small proportion of minority residents.

FIGURE 2.8



Data Source: US Census 1990; US Census 2000

FIGURE 2.9

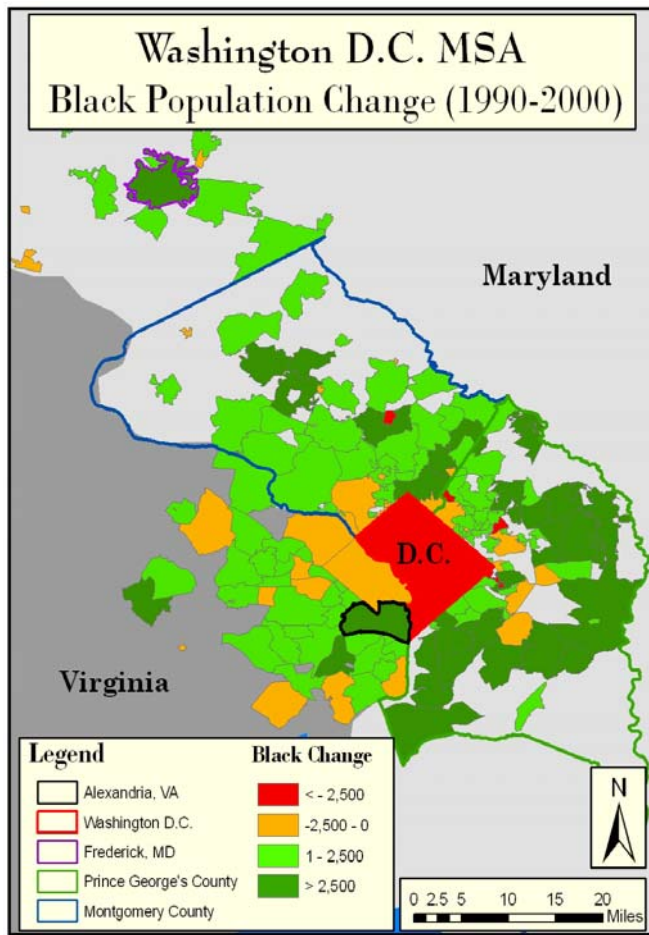
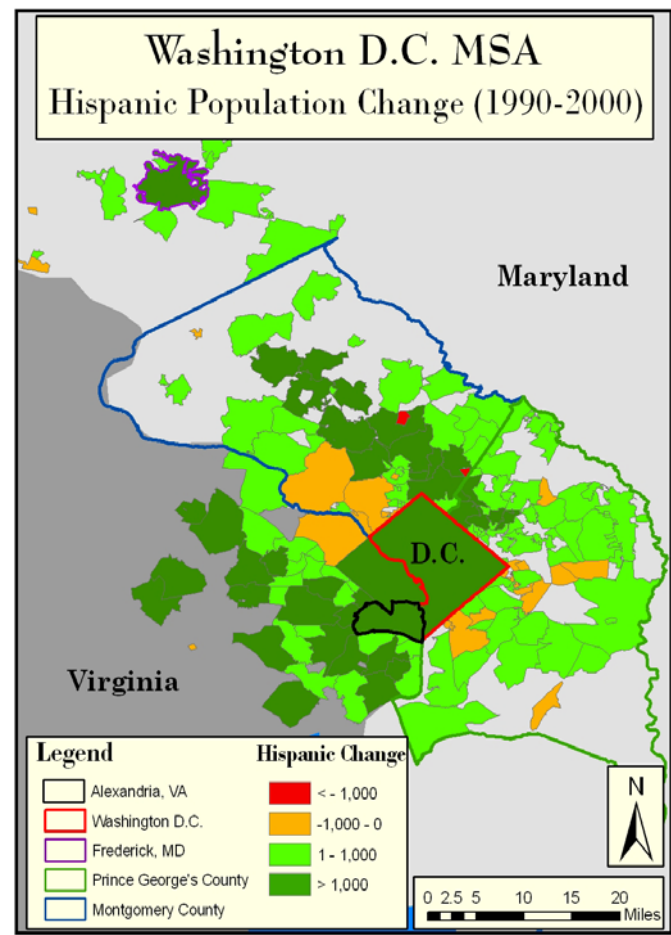


FIGURE 2.10



Data Source: US Census Bureau, US Census 1990; US Census 2000

The Washington, D.C. MSA has a large population that is increasing in numbers throughout most of the MSA. In places where the population is declining (Washington and some inner suburbs), the overall minority population is also declining, but the Hispanic population is increasing. The changing population dynamics of the MSA has been and will continue to be largely dependent on the housing stock available in each location. The way that zoning districts have shaped the availability of different housing units will likely be a determinant in how the growing minority population settles within each of these places.

CHAPTER 3: METHODOLOGY

The major data sources of this study consist of the U.S. Census 2000, Census Tiger/Line shapefiles, local zoning maps, and local zoning regulations. I used this data to compile racial and ethnic population figures within each zoning district of each locality. This chapter provides the definition of key terms used in this report and details the methodology involved in this study. More detailed information on data sources and the methodology in this study can be found in the appendix.

DEFINITIONS

The following terms are used to characterize certain racial/ ethnic groups throughout the report, and unless specified otherwise shall be defined as follows:

Minority – Refers to the sum of all racial and ethnic minority groups. These groups include: Blacks, Hispanics, Asians, American Indians and Alaska Natives, Native Hawaiians and Other Pacific Islanders, Some Other Race and people comprised of more than one race. Minorities are considered to include any person that does not claim to be non-Hispanic and white alone.

White - Refers to the non-Hispanic white population

Black – Refers to the population that claims black as their only race.

Hispanic – Refers to the population claiming to be of Hispanic origin, regardless of race.

METHODOLOGY

Using GIS (geographic information system), I manually assigned a zoning variable to each Census block. Since many Census blocks contain numerous zoning districts within their boundaries, I had to develop a set of criteria to assign zoning variables to Census blocks overlapping numerous zoning districts. If a Census block contains residential zoning districts and commercial or other zoning districts, I assigned the Census block to a residential zoning district regardless of the size of the commercial or other zoning districts. I assigned Census blocks to the residential zoning district

that covers the majority of the area of that block. When two or more residential zoning districts occupy nearly equal portions of the Census block, I assigned the Census block to the zoning district with the highest permitted density. If no residential district is located within the Census block, I assigned it to the commercial or other zoning district that occupies the largest portion of the block. The appendix contains a detailed discussion of this process and the reasoning for assigning zoning variables in this fashion.

Once zoning district variables were assigned to each Census block, I was able to analyze the racial composition of each zoning district. To do this, I conducted a number of analyses. These analyses involved statistical summaries, map creation, index calculation and other data analysis. I created various maps displaying the racial distribution across zoning district type in each site within my study area. One form of map that I created looks at how different racial and ethnic groups cluster within certain types of zoning districts. I created these cluster maps using GeoDa software. These maps code Census blocks by the proportion of the population that belongs to a certain racial/ ethnic group and whether that proportion is consistent with neighboring blocks. These cluster maps help visualize the location and amount of racial and ethnic clustering that occurs within certain zoning districts.

For each zoning district, I created several segregation indices. I created the dissimilarity index, the interaction index, the isolation index, the delta index and Theil's index. The dissimilarity index measures the evenness of the distribution of two different groups, blacks and whites for example. The index results in a number between 0 and 1 and represents the proportion of the population of one of these two groups (typically the minority group) that would have to move in order to reach an even distribution among the two groups. I calculated the dissimilarity index using the following equation (Massey and Denton, 1988):

$$D = \frac{1}{n} \sum_{i=1}^n [t_i | p_i - P| / 2TP(1 - P)]$$

t_i = Total Population of Geographic Unit i
 p_i = Minority Proportion of Geographic Unit i
 T = Total Population of Entire City/ County/ Zoning District
 P = Minority Proportion of Entire City/ County
 n = Number of Geographic Units

The interaction index and isolation index measure residential exposure – the potential or lack of potential for interaction between two groups (Hispanics and non-Hispanic whites, for example). The results of the interaction index give the likelihood that a member of one group (typically a minority group) resides in the same area as a member of the other group (typically the non-minority group). The isolation index measures the likelihood that the member of the

minority group will reside in the same area as another member of the same minority group. I used the following equations for the interaction and isolation indices (Massey and Denton, 1988):

Interaction Index:

$${}_xP^*_y = \sum_{i=1}^n [x_i/X][y_i/t_i]$$

x_i = The number of group X members in Geographic Unit i
 X = The number of group X members in Entire City/
County/ Zoning District
 y_i = The number of group Y members in Geographic Unit i
 t_i = Total Population of Geographic Unit i

Isolation Index:

$${}_xP^*_x = \sum_{i=1}^n [x_i/X][x_i/t_i]$$

x_i = The number of group X members in Geographic Unit i
 X = The number of group X members in Entire City/
County/ Zoning District
 t_i = Total Population of Geographic Unit i

The delta index is a measure of concentration that quantifies the “relative amount of physical space occupied by a minority group in the urban environment” (Massey and Denton, 1988). Minority groups that are relatively unevenly spread throughout the city and occupy a very small portion of the city’s area would likely be considered more segregated than if the unevenly distributed minority group occupied a larger portion of the city’s area. The delta index measures the density of people belonging to a minority. The result of the index (between 0 and 1) signifies the proportion of people belonging to a minority that would need to move in order to reach a homogenous density. I used the following equation for the delta index (Massey and Denton, 1988):

$$DEL = 1/2 \sum_{i=1}^n |[x_i/X - a_i/A]|$$

x_i = The number of group X members in Geographic Unit i
 X = The number of group X members in Entire City/
County/ Zoning District
 a_i = Land area of Geographic Unit i
 A = Land area of Entire City/ County/ Zoning District

Theil’s index is a measure of evenness of the population, but unlike the dissimilarity index, it is decomposable to smaller geographies. In my case, I can decompose a city-wide Theil’s index figure to yield index figures for each zoning district and each type of zoning district. To calculate the Theil’s index, I first had to calculate the Entropy (E) for each Census block and the city-wide population. E is calculated as follows (Fischer et al., 2004):

$$E = p_i \ln\left(\frac{1}{p_i}\right) + (1 - p_i) \ln\left(\frac{1}{1 - p_i}\right)$$

p_i=Proportion of minority population in block or city

After calculating E for each geography, I was able to calculate Theil's Index (H) for the entire city. To do so, I used the following equation (Fischer et al., 2004):

$$H = \sum_{s=1}^S \frac{T_s}{T} \left(\frac{E - E_s}{E} \right),$$

T = Total population in city
T_s = Total population in Census block
E = Entropy for entire city
E_s = Entropy for Census block

The resulting index number will range from 0 to 1, with 0 implying total integration and 1 signifying complete segregation of the group being analyzed. This index is helpful because it is decomposable. I decomposed the index to examine the amount of segregation in each zoning district. These zoning district segregation indices can be interpreted as the amount to which each zoning district contributes to the overall, city-wide Theil's index. Naturally, zoning districts with higher populations will contribute more to city-wide segregation. To account for this, I also standardized each zoning district index by the total population residing in each district.

These segregation indices will help explain the racial distribution across entire jurisdictions and within particular zoning districts. Another form of analysis involved creating histograms showing the amount of Census blocks that fall within a certain range of minority proportion. Those zoning districts that have many Census blocks with a minority or black proportion greater than 90% better facilitate racially-segregated areas than zoning districts without many blocks with that high of a minority or black proportion. Consequently, zoning districts that have many Census blocks with a minority or black proportion less than 10% and few Census blocks with minority proportions greater than 70% are less accommodating of minority settlement.

The various analyses conducted in this study should help to further understand the connection between zoning and racial segregation. Statistical summaries of the demographics within each zoning district will provide numerical data showing the correlation between zoning and racial distribution. Maps will help visualize this correlation. The various segregation indices will further explain racial segregation within and between zoning districts. Finally, histograms will show more than the racial composition of each zoning district – they will point out the zoning districts in which minority segregation and white isolation more frequently occur.

CHAPTER 4: WASHINGTON, D.C.

Washington had a 2000 population of approximately 572,000 people. These residents are located in a fairly small area of under 44,000 acres. This population is about 60% black and 8% Hispanic. This high minority population makes Washington an interesting location to analyze. The high black population and the fact that central cities have typically been highly-segregated (Alba and Logan, 1993) indicates that Washington, D.C. is likely to see high levels of segregation. It also indicates that Washington is likely to have high minority populations in most zoning districts. This chapter will analyze racial distribution and segregation trends across the various zoning districts within Washington, D.C.

ZONING ORDINANCE AND MAP

Washington was one of the earliest cities in the United States to enact a zoning ordinance. D.C.'s first zoning ordinance became effective on March 1, 1920. This early zoning ordinance controlled for use type (residential, commercial one, commercial two, or industrial), building height and lot coverage. In 1958, Washington adopted a new ordinance based on the 1956 Lewis Plan. With this new ordinance, D.C. began regulating density through a measure of floor-area-ratio. The city's present zoning ordinance is an amended form of this 1958 zoning ordinance (District of Columbia, 2007).

Washington's current zoning ordinance consists of 10 residential zoning districts, 10



commercial zoning districts, a government zoning district, 2 office/ special purpose zoning districts, and 7 manufacturing/ industrial zoning districts. D.C.'s residential and commercial districts are cumulative, meaning that districts that permit high-intensity uses such as shopping centers or apartments will also permit the uses allowed by lower-

intensity, single-family districts. The industrial districts are cumulative with regards to commercial uses, but these districts do not permit the establishment of new residences. Two zoning districts permit only single-family detached residential units, R-1-A and R-1-B (shown in Figure 4.1). Three other zoning districts(R-2, R-3 and R-4) are limited to single-family homes, duplexes and, in the case of R-3 and

TABLE 4.1 – Washington, D.C. Zoning Districts

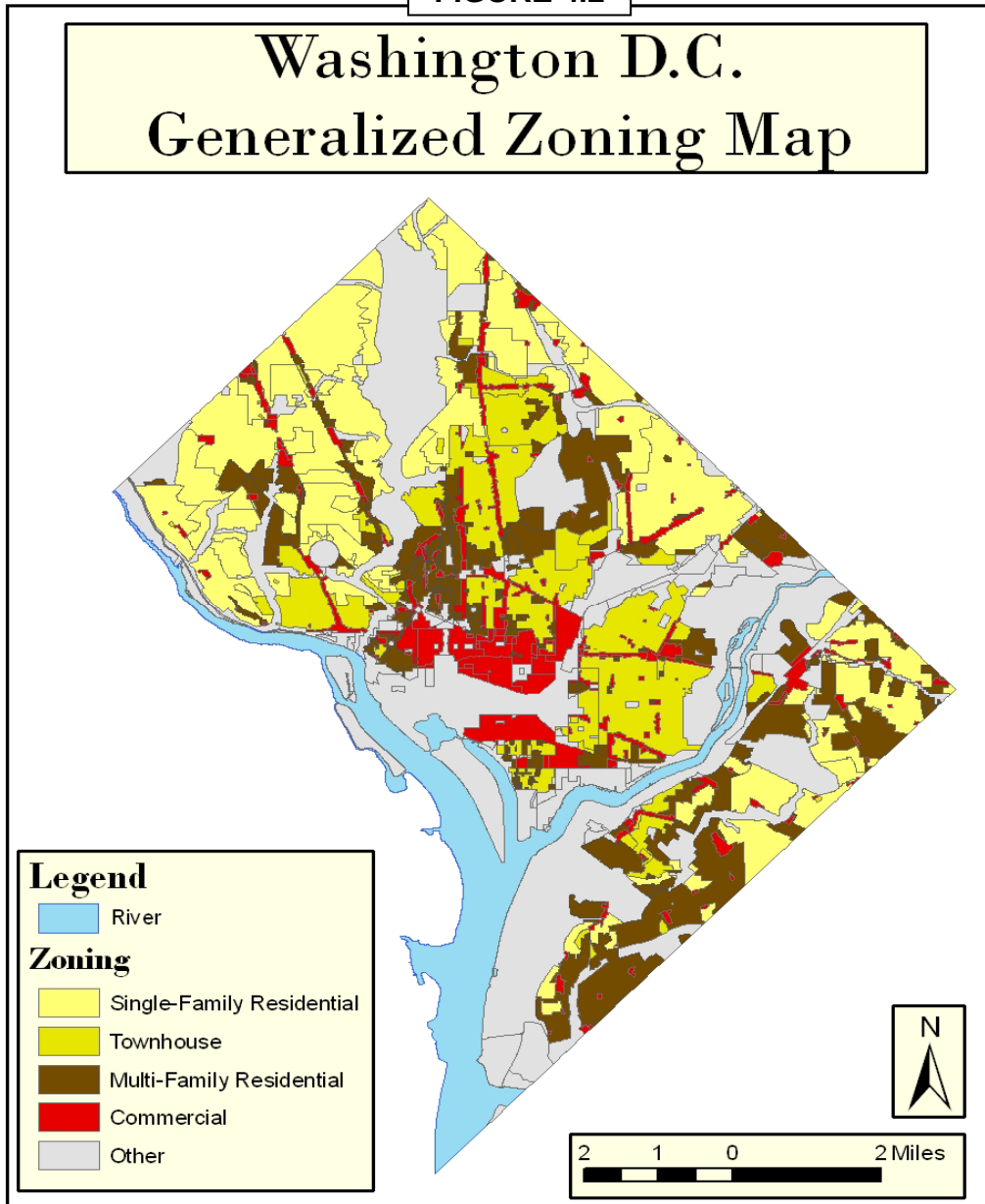
Density	Residential		Commercial		Other	
	District	Description	District	Description	District	Description
Low ↓ High	R-1A	Single-Family Detached	C-1	Commercial	GOV	Government
	R-1B	Single-Family Detached	C-2A,B,C	Commercial	SP-1,2	Office
	R-2	Single-Family Attached	C-3A,B,C	Commercial	C-M1,2,3	Manufacturing
	R-3	Single-Family Attached	C-4	Commercial	W-1,2,3	Light Industrial
	R-4	Single-Family Attached	C-5	Commercial	M	Industrial
	R-5A	Multi-Family	CR	Commercial		
	R-5B	Multi-Family				
	R-5C	Multi-Family				
	R-5D	Multi-Family				
	R-5E	Multi-Family				

Source: City of Washington

R-4, townhouses. Districts R-5A through R-5E permit all residential dwelling types ranging from single-family detached homes to multi-family apartment units. Table 4.1 lists the city's various zoning districts and types of uses permitted in each district.

D.C.'s zoning map is illustrated in Figure 4.2. The zoning districts have been aggregated into classes for easier viewing. R-1-A, R-1-B and R-2 comprise the single-family districts. R-3 and R-4 make up the townhouse districts, while districts R-5-A through R-5-E make up the multi-family sections of the map. The map shows that Washington has a great deal of single-family-zoned land to the north and west of the city center. Multi-family, townhouse and commercially-zoned land dominate central D.C., while the southern and eastern portions of the city are largely covered by multi-family zoning districts.

FIGURE 4.2



Source: City of Washington

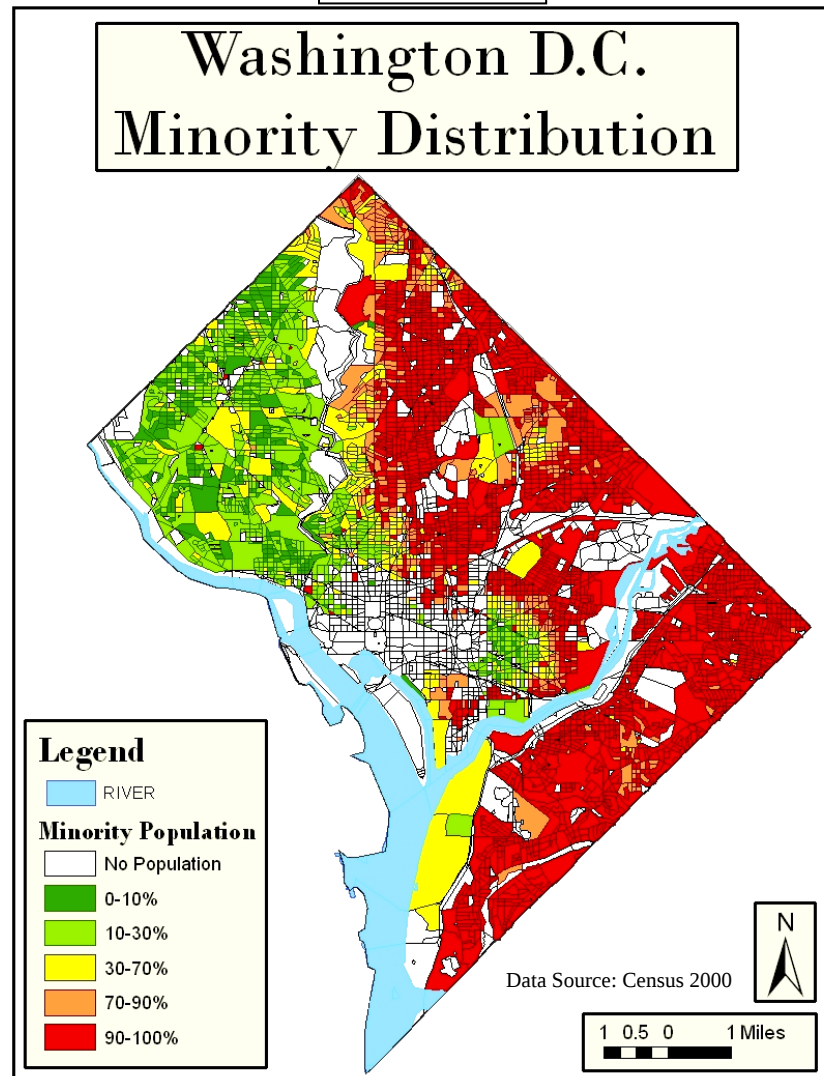
RACIAL/ ETHNIC DISTRIBUTION

Visual Analysis

Although the city's minority population distribution does not perfectly coincide with zoning districts, there are key trends showing some degree of correlation. Figure 4.3 shows the minority proportion of each Census block within the city. There is a significant difference between the western and eastern halves of the city, with minority population dominating most

of the eastern half of the city and largely absent from the western portion of the city. Washington's long history of segregation and development is likely a contributing factor in this minority distribution.

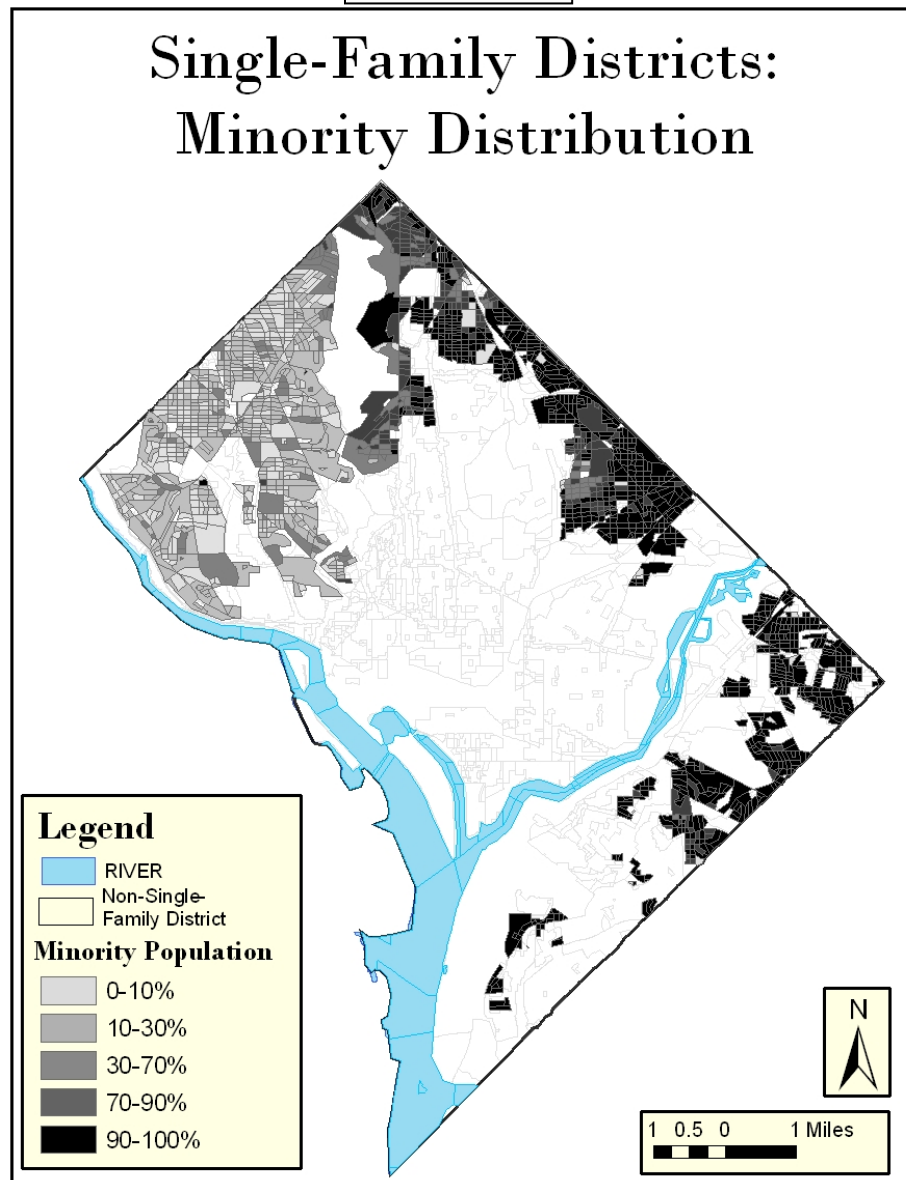
FIGURE 4.3



Figures 4.4 and 4.5 show Washington's racial distribution within single-family zoning districts and multi-family zoning districts, respectively. These distribution patterns show that more single-family blocks have low proportions of minorities than multi-family blocks. There are, however, a large number of single-family blocks with more than 90% of the population belonging to a minority. Minority population corresponds more to the city's east-west divide than to the type of zoning district regulating the land. The zoning districts, however, are not

distributed equally between the city's western and eastern halves. The western half of the city contains a great deal of single-family zoning, but has relatively small areas devoted to multi-family zoning. This small amount of multi-family zoning in the city's western half could be a contributing factor to the city's lack of racial integration.

FIGURE 4.4

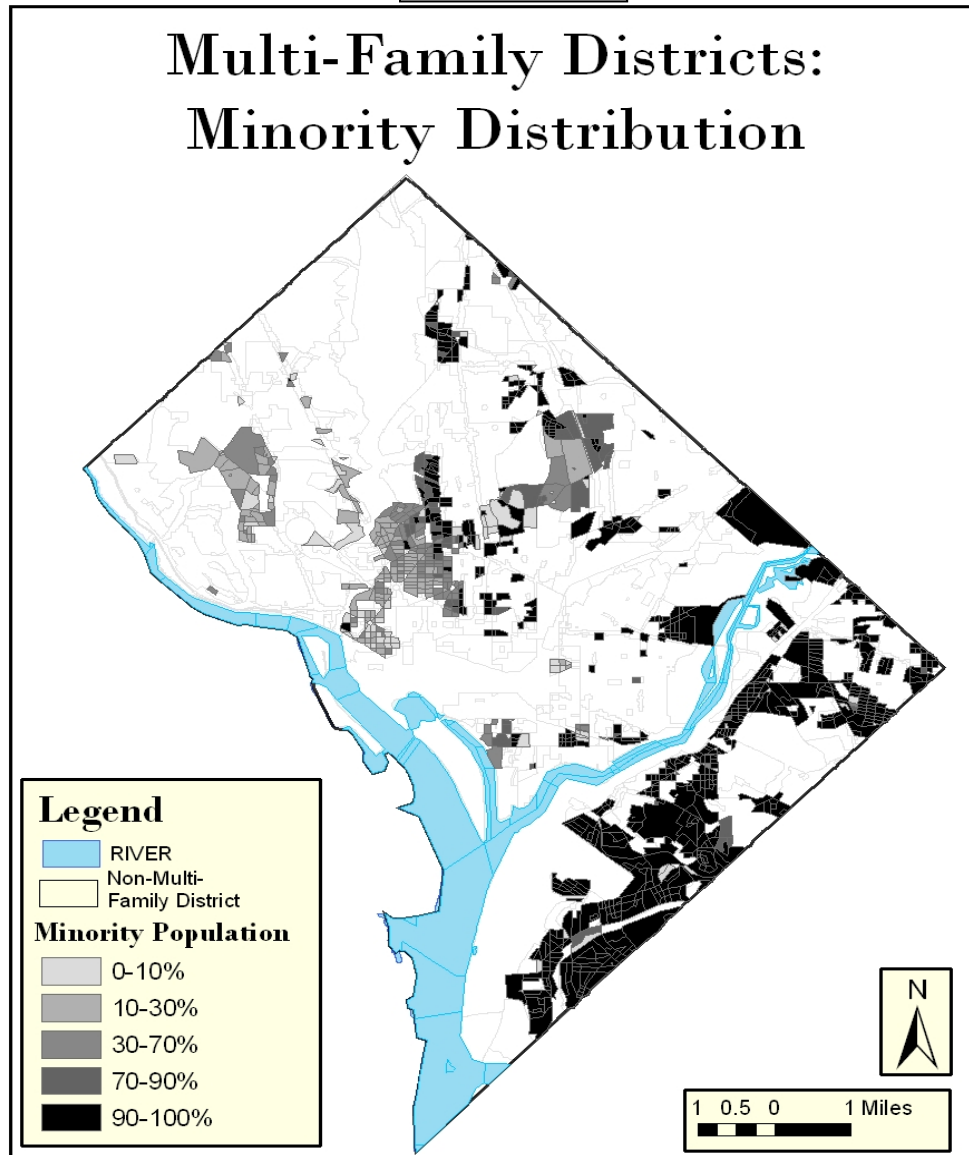


Data Source: Census 2000; City of Washington

The fact that the western portion of the city contains mostly single-family zoned areas could be limiting housing affordability and rental opportunities. Since minorities require more rental units (Pendall, 2000) and have lower median incomes than non-minorities (U.S. Census

2000) in turn making minorities more dependent on affordable housing, minorities likely have more trouble moving into this large area of single-family zoning districts.

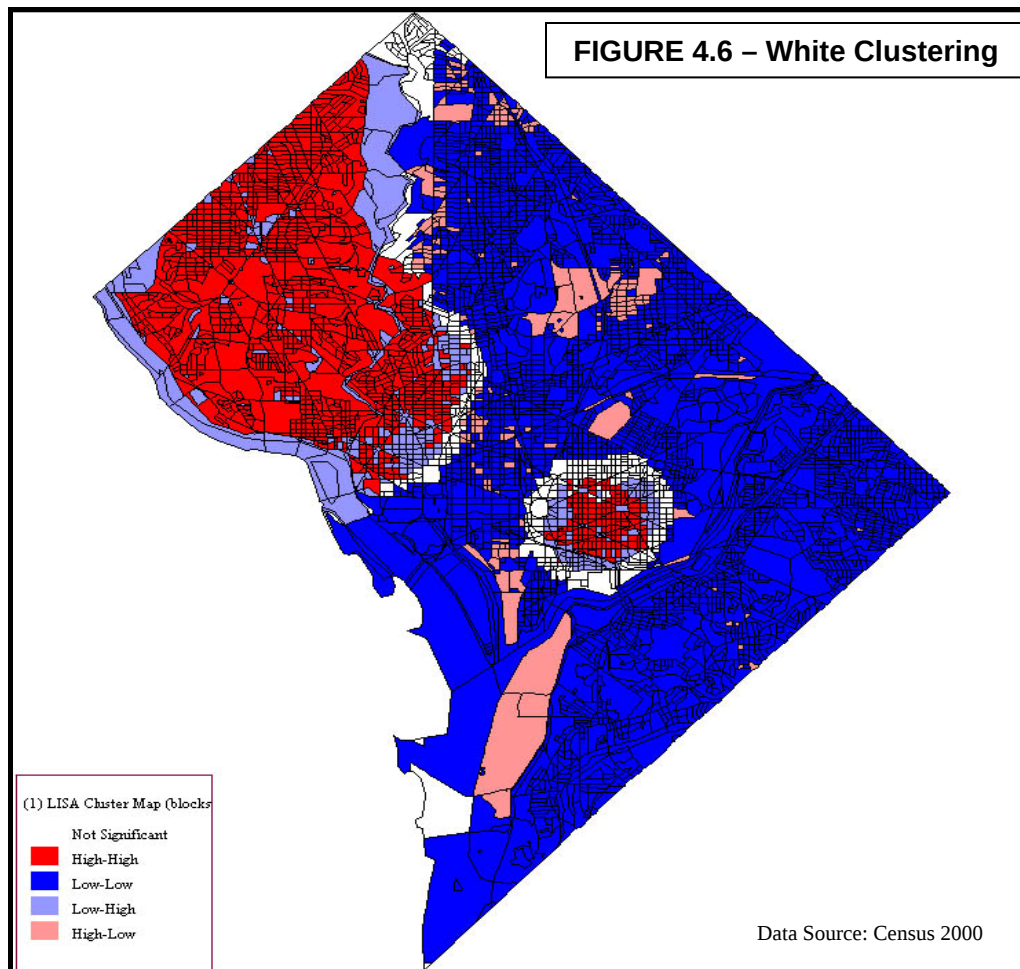
FIGURE 4.5



Data Source: Census 2000; City of Washington

Cluster maps (Figures 4.6 through 4.13) give further insight into the spatial patterns of racial and ethnic settlement in Washington, D.C. Cluster maps not only show the racial composition of each Census block, but they also show clustering patterns by considering neighboring Census blocks. Blocks shown in red (“High-High”) represent the presence of clustering - blocks that are high in a certain racial/ ethnic group and near other blocks that are

also high in the same proportion. Blue blocks (“Low-Low”) are those that are low in the population of one group and near other blocks that are also low in that group’s population. Light red blocks (“High-Low”) show areas high in the population group but near areas low in the population group, while light blue blocks (“Low-High”) represent areas low in that population but near areas high in that population.



White clustering, shown in Figure 4.6, occurs in significant amounts in the western edge of the city and in a small region in central D.C. The first of these two white cluster regions consists of mainly R-1-A and R-1-B (low density single-family) zoning. The white clustered region in central D.C., however, consists mainly of R-3 and R-4 (townhouse) zoning. Thus, low-density, single-family zoning corresponds with the largest white cluster in the city. The low-density nature of these zoning districts could be influencing the persistence of this white cluster, but the presence of white clusters in other higher-density districts shows that low-density zoning does not determine the location of all white clusters.

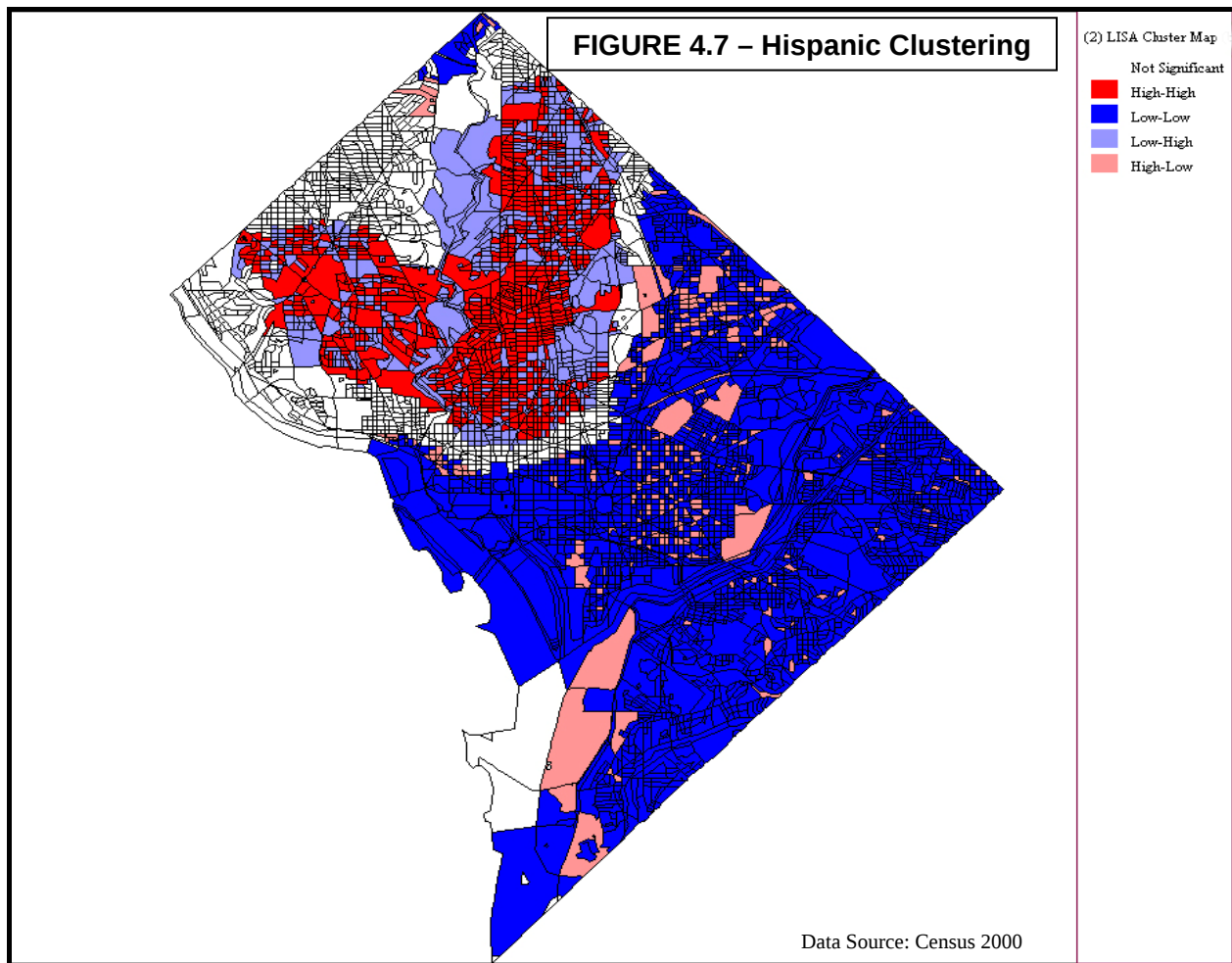
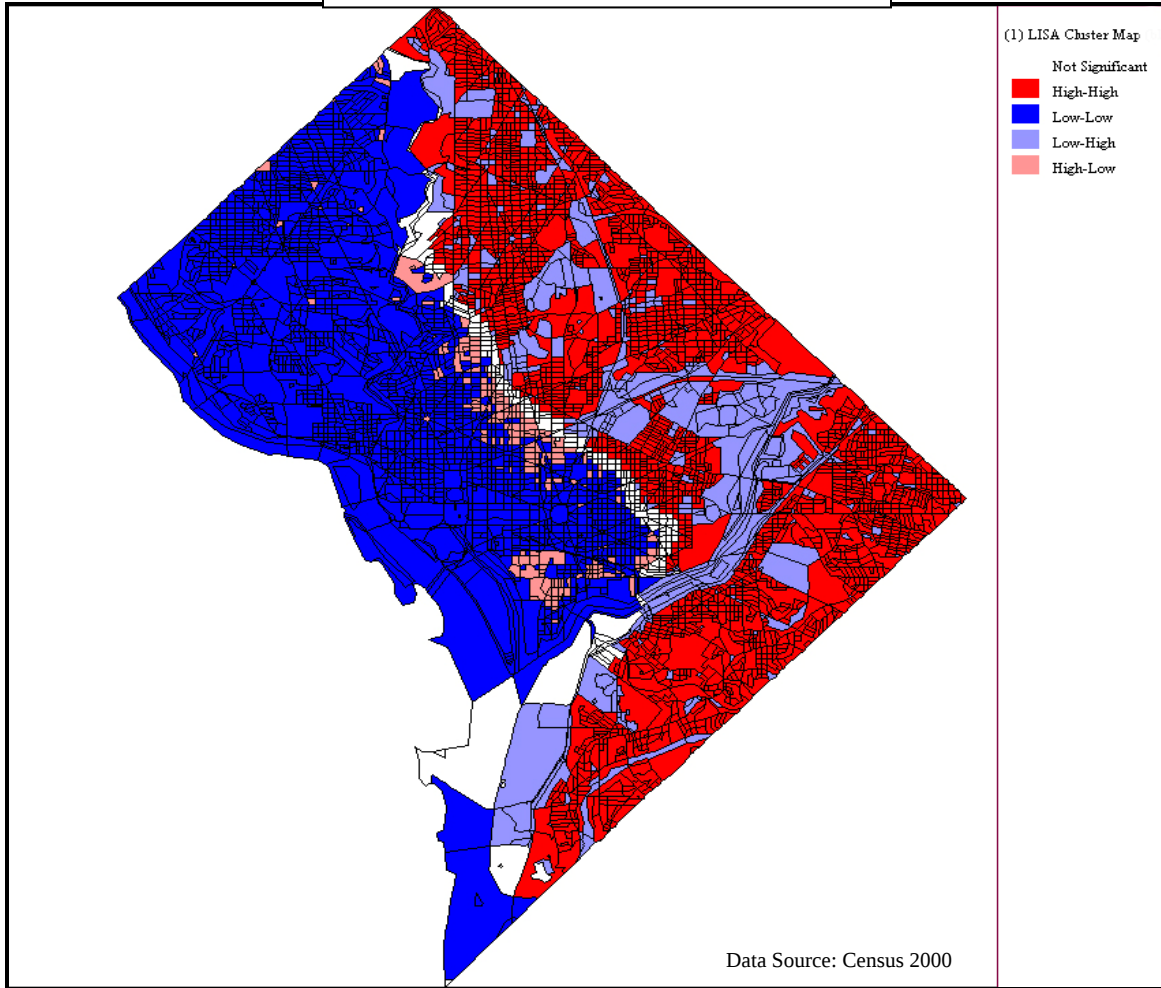


Figure 4.7 shows Hispanic clustering. Most of the Hispanic clustering also occurs in the western portion of the city, although Hispanic clustering is not as concentrated as white clustering. Hispanic-clustered areas cover a variety of zoning districts, but multi-family and townhouse zoning districts comprise a large portion of the Census blocks with Hispanic clustering.

As expected from the city's overall racial distribution, black clustering (shown in Figure 4.8) occurs primarily across the eastern half of the city. There are some Census blocks with a high proportion of black residents in the city's western half, but none of these Census blocks met the clustering threshold of being located near other blocks with high black proportions. Similarly, there are areas of low black population in the eastern half of the city, but there are not low black population areas meeting the threshold of being in an area of low black population.

Considering that black clustering covers such a large portion of Washington's area, it is not surprising that these clustered areas are regulated by many different zoning districts. The

FIGURE 4.8 – Black Clustering



eastern half of the city contains more townhouse and multi-family zoned areas than the western half of the city. Black clustering areas, however, also occupy large areas of single-family zoning, especially R-1-B and R-2 zoning. Zoning does not perfectly coincide with black clustering, but in black-clustered areas, there are far more housing opportunities in townhouse and multi-family zoning districts than in white-clustered areas.

Figures 4.9 through 4.13 show clustering patterns that occur within zoning districts based on the type of residential dwelling units permitted. The maps show that although white clustering is more frequent in single-family districts and minority clustering is more prevalent in townhouse and multi-family districts, there is a significant amount of white and minority clustering in other zoning district types as well. Minority clustering (Figures 4.9 – 4.11) occurs in multi-family, townhouse and single-family districts, but single-family districts have the most areas low in minority population and near other areas low in minority population. White

clustering (Figures 4.12 – 4.13) occurs in both multi-family and single-family districts, but occurs to a greater extent in single-family districts.

FIGURE 4.9 – Minority Clustering: Multi-Family Districts

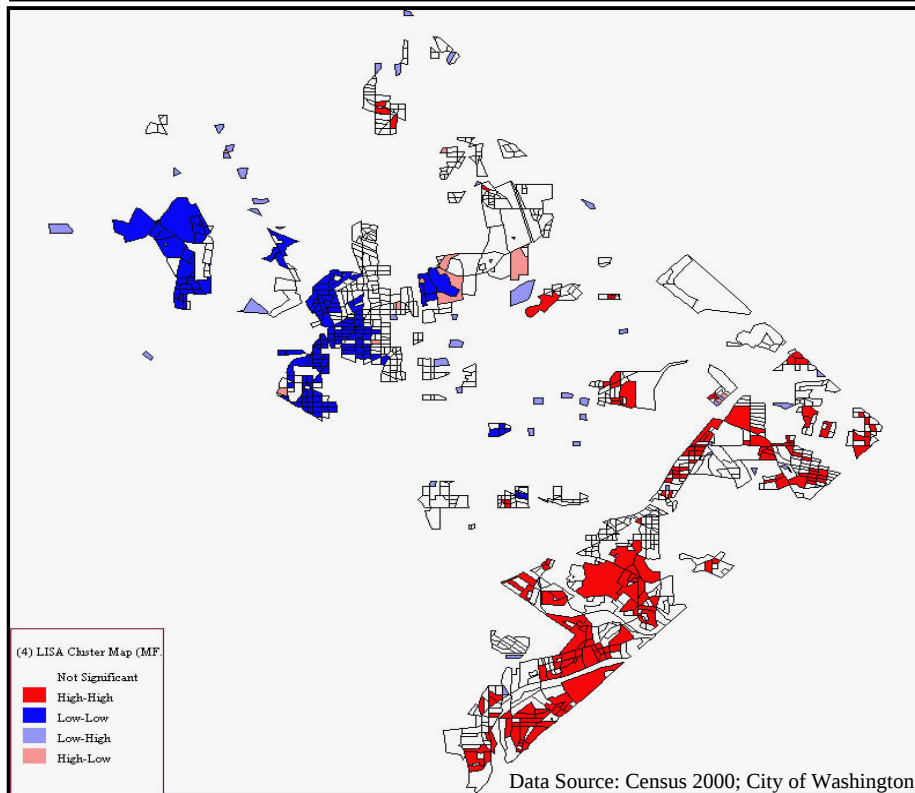


FIGURE 4.10 – Minority Clustering: Townhouse Districts

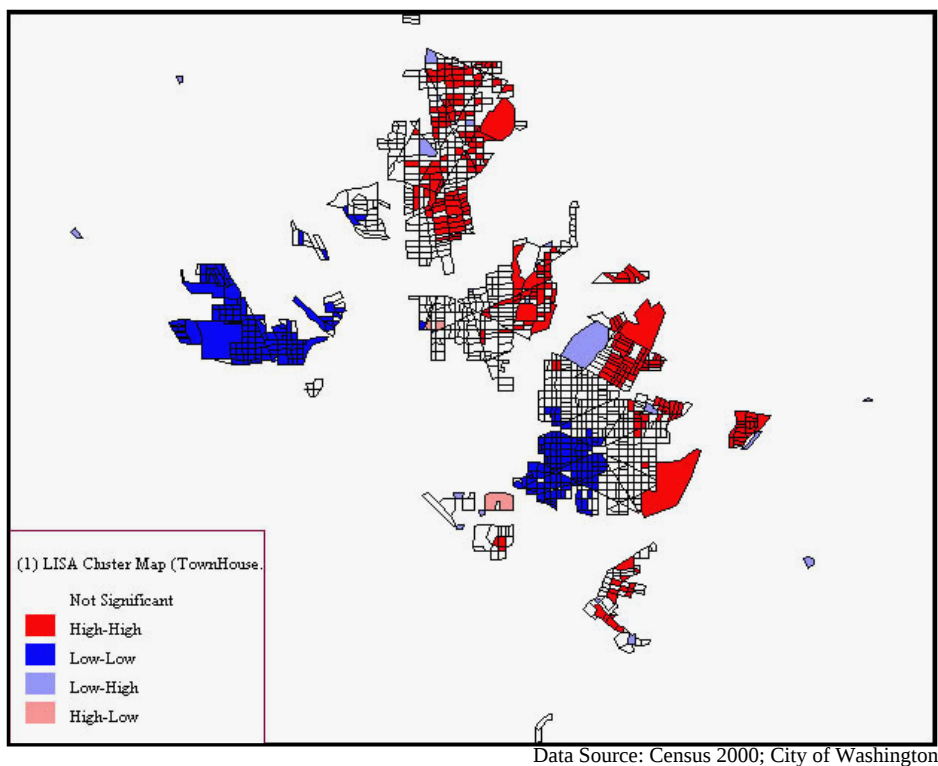


FIGURE 4.11 – Minority Clustering: Single-Family Districts

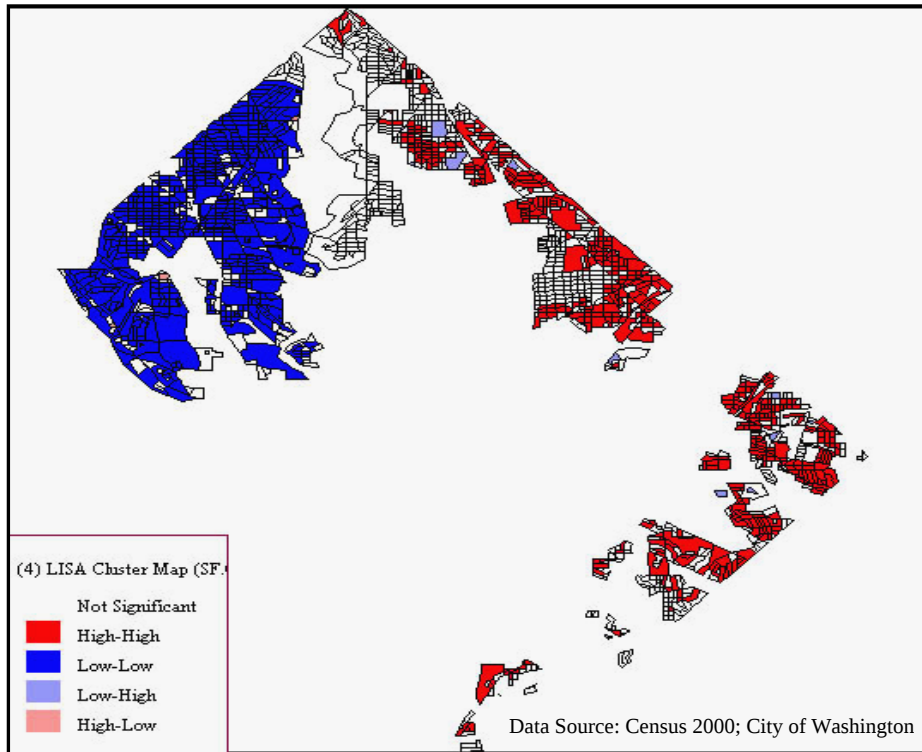


FIGURE 4.12 – White Clustering: Multi-Family Districts

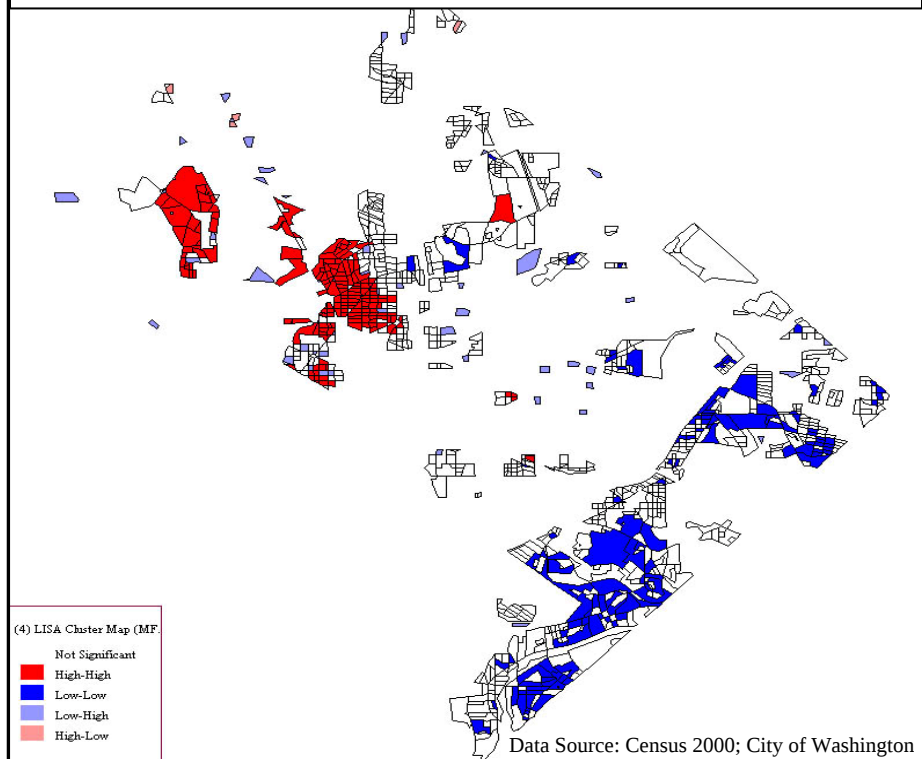
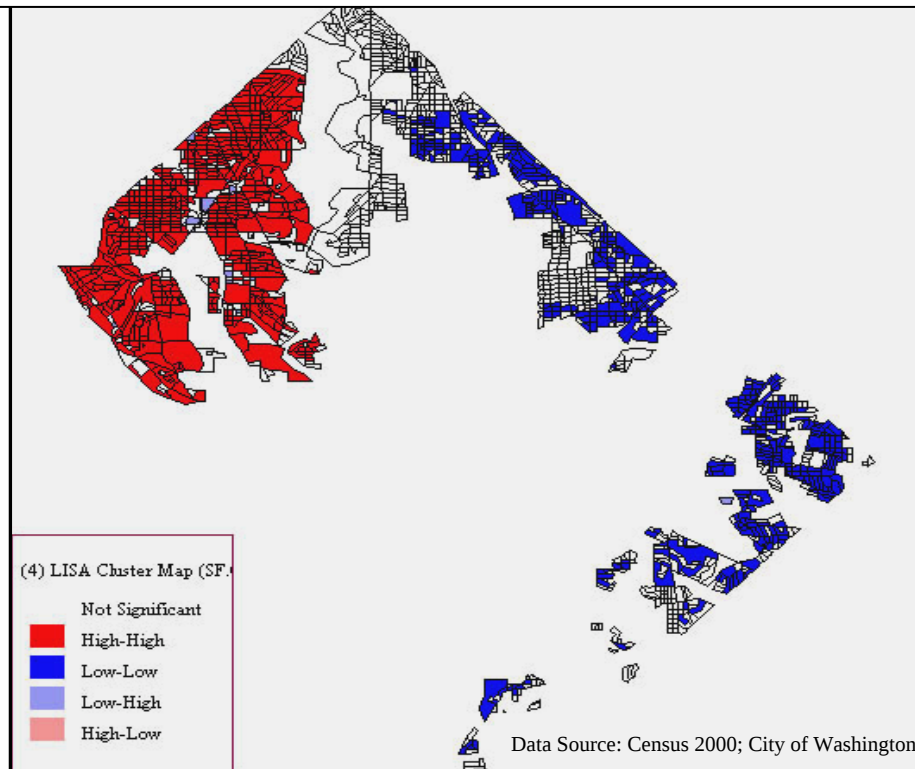


FIGURE 4.13 – White Clustering: Single-Family Districts



Quantitative Analysis

Although these maps give an excellent visual representation of D.C.'s racial distribution relative to zoning, a detailed statistical analysis will help to quantify this relationship. This statistical analysis of the D.C. zoning districts shows that certain zoning districts contain low proportions of minority populations while other districts are mainly composed of minorities. Table 4.2 shows each zoning district's population by race and ethnicity. The R-4 and R-5-A (Figure 4.16) zoning districts accommodate the highest black and overall minority populations. This is not surprising, considering that these zones have the highest total populations. These districts

FIGURE 4.14 – R-1-A District



also permit high-density developments that can be more affordable than single-family districts. The R-5-A district is the multi-family zoning district with the largest overall population.



R-5-E, R-5-C and R-1-A zoning districts contain the smallest numbers of minorities. R-5-E (Figure 4.15) and R-5-C were not expected to have such low numbers of minorities because these zoning districts permit some of the highest-density residential developments in the city. Much of this low minority population, however, can be attributed to these zoning districts' low total populations. The R-1-A zoning district (Figure 4.14) is the lowest-density district and was expected to have a fairly low number of minority residents.

Upon aggregating these zoning districts into zoning types (Table 4.3), we can see that minority, black and Hispanic populations steadily increase as the zoning district permits a wider array of housing types. The white population increases as well, but not nearly to the magnitude of minority populations. The white population in multi-family districts is about 30% higher than in single-family districts, but the black population is over 100% higher in multi-family districts. The Hispanic population is more than 200% higher in multi-family districts than in single-family districts. On average, multi-family districts contain about a 13% higher minority proportion than single-family districts. These population proportions make it apparent that minorities much more frequently reside in areas that are presently zoned for multi-family and townhouse use.

TABLE 4.2 – Racial/ Ethnic Composition of Zoning Districts

Zoning	Number Blocks	Area (Acres)	Total Population	White Population	Black Population	Hispanic Population	Minority Population
R-1-A	186	2,583	17,318	12,356	2,907	863	4,962
R-1-B	1,109	6,924	65,102	29,575	29,642	3,043	35,527
R-2	623	3,034	51,294	7,361	41,417	1,344	43,933
R-3	355	1,791	42,504	17,007	21,594	2,170	25,497
R-4	993	4,171	121,409	23,388	81,739	12,632	98,021
R-5-A	642	5,867	131,047	16,495	106,648	4,610	114,552
R-5-B	324	1,787	69,923	23,679	31,133	11,218	46,244
R-5-C	7	37	2,659	1,049	941	321	1,610
R-5-D	100	861	35,579	13,249	14,565	4,965	22,330
R-5-E	43	148	13,123	5,595	3,564	1,976	7,528
Totals	4,382	27,203	549,958	165,856	334,150	43,142	400,204

Data Source: U.S. Census 2000; City of Washington, D.C.

TABLE 4.3 – Racial/ Ethnic Composition by Zoning Type

Zoning	Number Blocks	Area (Acres)	Total Population	White Population	Black Population	Hispanic Population	Minority Population	Percent Minority
Single-Family	1,918	12,541	133,714	52,166	73,966	5,250	84,422	63%
Townhouse	1,348	5,962	163,913	45,029	103,333	14,802	123,518	75%
Multi-Family	1,116	8,700	252,331	68,661	156,851	23,090	192,264	76%

Data Source: U.S. Census 2000; City of Washington, D.C.

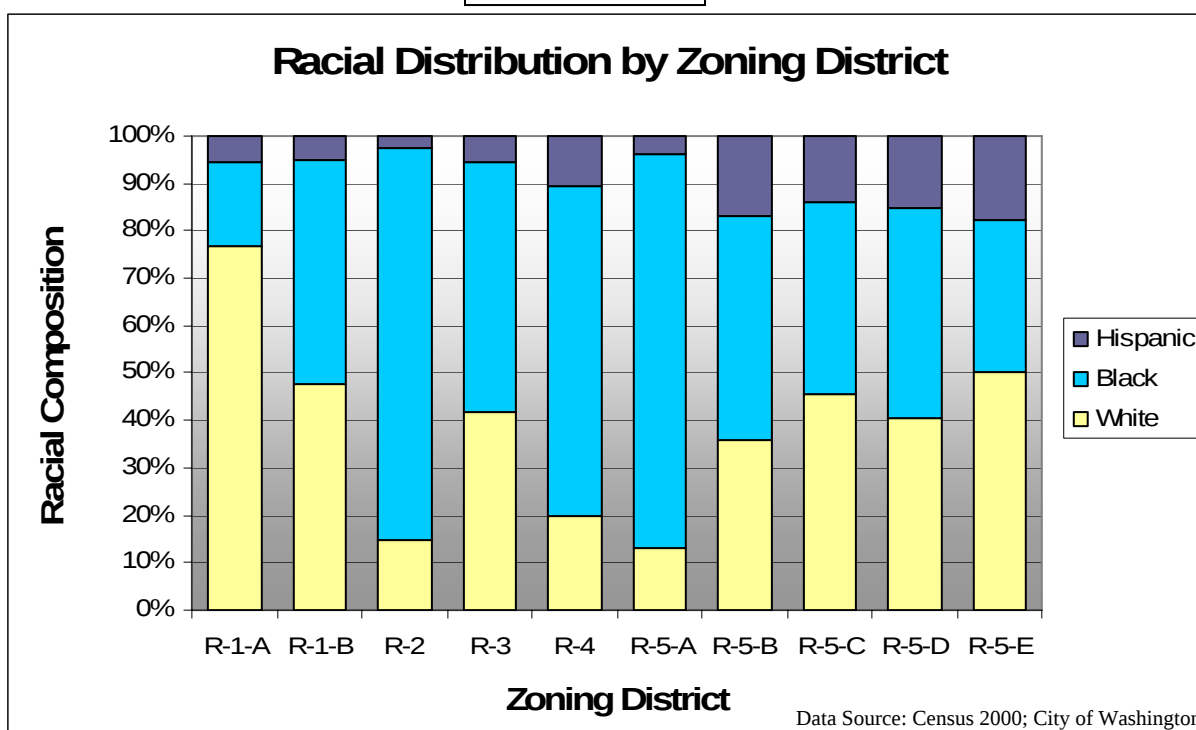
Chart 4.1 shows the racial composition of each district. As expected, single-family districts (R-1-A and R-1-B) have some of the highest proportions of white population. The R-1-A district only permits low-density development, and consequently requires residents of this district to own larger, more expensive tracts of land.

Contrary to the R-1-A district, the R-5-A district contains the highest proportion of blacks and overall minority population. Although this district permits many housing types, it is not the highest-density zoning district. It is, however, the multi-family district that covers the most land within the city and contains the largest population in the city. The R-5-A district is clearly the most widespread option for multi-family housing in the city, and minorities live here more than in other districts.

The higher-density multi-family districts (R-5-B, R-5-C, R-5-D and R-5-E), however, have an unexpectedly high proportion of white residents. Since the lowest-density district (R-1-A) district has the fewest minorities, one would expect the largest proportion of minorities to

locate in the highest-density districts. Rather, it appears that minorities are more commonly residing in the R-2, R-4 and R-5-A districts. The fact that the highest proportions of minorities are not found in the highest-density zoning districts indicates that zoning districts do not completely correspond with the racial distribution of the city.

CHART 4.1



Segregation Trends

Although this demographic analysis suggest that the R-1-A district is less conducive to minority settlement and that the R-5-A district is the most commonly-inhabited zoning district by minorities, it is important to analyze white and minority distribution within each zoning district. First, a series of histograms illustrates the amount of blocks that have high, low and moderate minority proportions. Charts 4.2 and 4.3 show the number of Census blocks falling into different categories of black and Hispanic population proportions. By comparing the two charts, we see that most Census blocks contain a Hispanic population making up 0-10% of the block's total population. Considering that the city has only an 8% Hispanic population this is somewhat expected. Little Hispanic segregation occurs, however, as only 7 blocks in the entire city have Hispanic populations in excess of 70% of the block's total. The black distribution, however, shows that the majority of Census blocks throughout the city have black populations making up

either less than 10% of the total or more than 90% of the total population. Relatively few Census blocks contain much of a mixed black population. This phenomenon of higher levels of black segregation is not unique to Washington, D.C. The literature confirms that blacks face significantly higher levels of segregation than other minority groups such as Hispanics and Asians (Freeman, 2000; Frey and Farley, 1996; Alba and Logan, 1993).

CHART 4.2

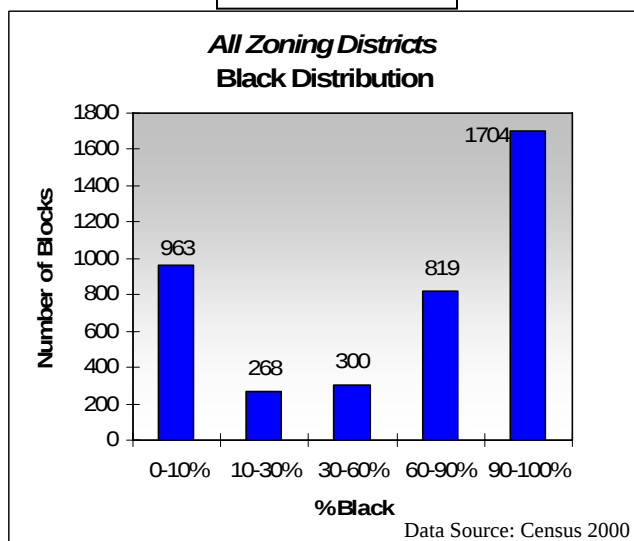
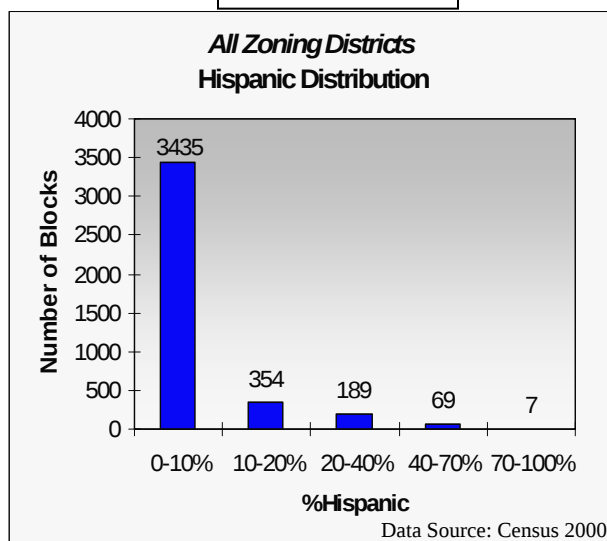
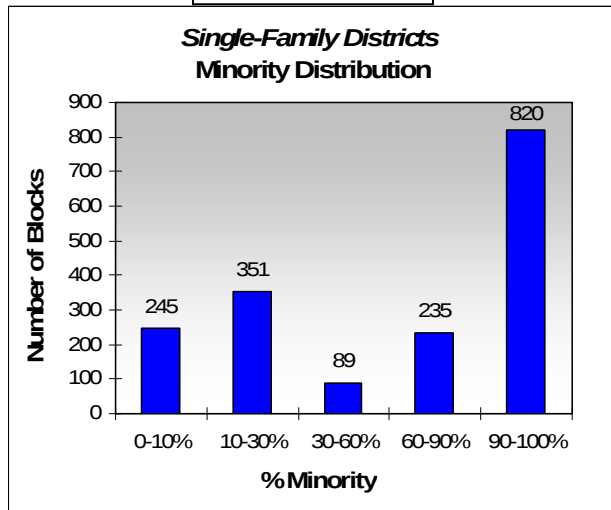


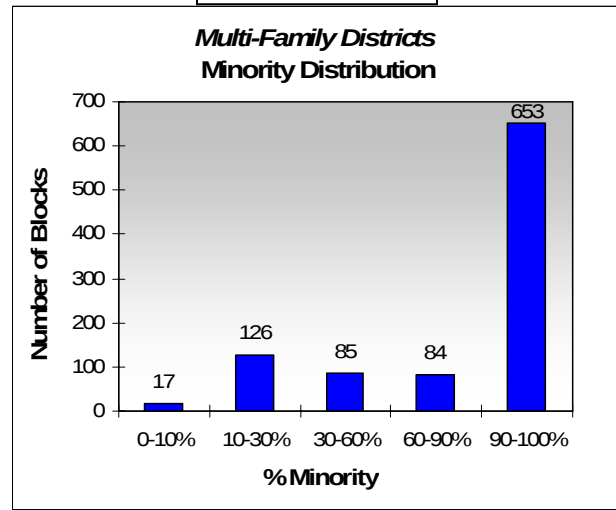
CHART 4.3



Charts 4.4 and 4.5 show how the minority population is distributed within single-family districts and multi-family districts. The charts show that in both zoning types, minorities are not well integrated, but minority integration occurs at higher rates in single-family zoning districts. Only about 30% of Census blocks in multi-family districts have a minority population that makes up between 10% and 90% of the total population. In single-family districts, about 40% of Census blocks fall in these three middle classes of minority population. Both single-family and multi-family districts have numerous blocks with high minority populations, but single-family districts have far more blocks with a minimal minority population.

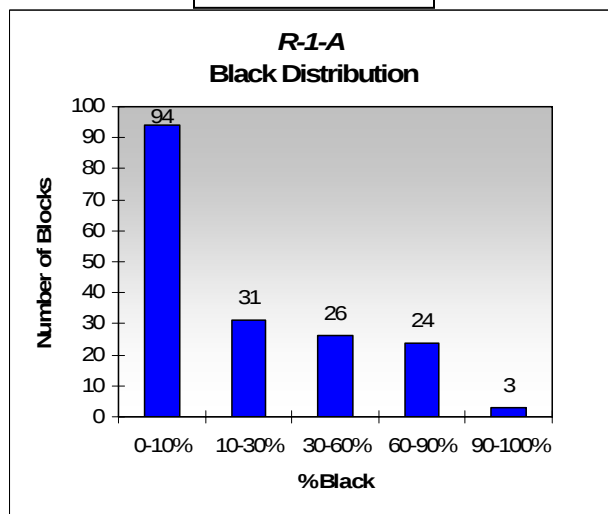
CHART 4.4

Data Source: Census 2000; City of Washington

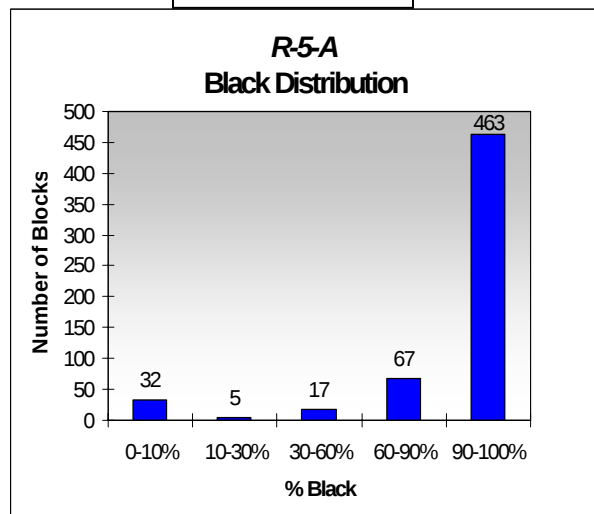
CHART 4.5

Data Source: Census 2000; City of Washington

Within these zoning types, two districts stand out as polar extremes for black population distribution (Charts 4.6 and 4.7). The R-1-A, single-family district has a majority of Census blocks with a black population of less than 10% of the block's total. The R-5-A district, on the other hand, has an overwhelming majority of Census blocks with a white population of less than 10%. Just as total minority populations corresponded with these two zoning districts' permitted densities, racially-segregated areas correlate with the two districts. The R-5-A district has much higher areas of black segregation, while the R-1-A district has more areas isolated from the black population.

CHART 4.6

Data Source: Census 2000; City of Washington

CHART 4.7

Data Source: Census 2000; City of Washington

The extent to which blacks, Hispanics and all minorities are integrated with the white population is further illustrated by segregation indices. These indices examine racial segregation occurring within zoning districts. By examining segregation within zoning districts, we can see which zoning districts accommodate higher levels of minority segregation and white isolation. If zoning is a major determinant of racial and ethnic segregation, we would expect white isolation to be highest in the low-density, single-family districts, while minority segregation would be more prevalent in multi-family districts.

The first of these segregation indices is the dissimilarity index, which measures the degree of evenness across a certain geography. A high dissimilarity index means that there is a high degree of segregation within this geography. Table 4.4 looks at dissimilarity indices of each of D.C.'s zoning districts. The table shows that segregation is high among blacks, whites, and the overall minority population. Hispanics, in comparison, are less segregated. Minorities within the R-5-A district are subject to higher levels of segregation than minorities in other zoning districts. Minorities that are able to reside in the R-1-A district are less segregated than other minorities throughout the city. If zoning influences minorities to settle in the R-5-A district, it could also be contributing to the higher level of segregation occurring in this district.

TABLE 4.4 – Dissimilarity Index

Zoning	Black-- Non-black	Hispanic-- Non-Hispanic	White-- Non-white	Minority-- Non- Minority
R-1-A	0.60	0.33	0.45	0.40
R-1-B	0.80	0.47	0.77	0.75
R-2	0.80	0.63	0.09	0.85
R-3	0.84	0.42	0.84	0.84
R-4	0.58	0.57	0.65	0.71
R-5-A	0.80	0.61	0.84	0.86
R-5-B	0.65	0.54	0.65	0.69
R-5-C	0.46	0.32	0.49	0.51
R-5-D	0.63	0.49	0.55	0.59
R-5-E	0.72	0.55	0.52	0.59
Single-Family	0.83	0.52	0.81	0.79
Townhouse	0.65	0.55	0.72	0.76
Multi-Family	0.78	0.59	0.75	0.77
All Zones	0.75	0.56	0.75	0.77

Data Source: U.S. Census 2000; City of Washington, D.C.

TABLE 4.5 – Interaction Index

Zoning	Black-White	Hispanic-White	Minority-White
R-1-A	0.43	0.72	0.55
R-1-B	0.11	0.49	0.18
R-2	0.13	0.33	0.04
R-3	0.05	0.34	0.12
R-4	0.08	0.13	0.10
R-5-A	0.02	0.24	0.04
R-5-B	0.12	0.23	0.17
R-5-C	0.25	0.27	0.29
R-5-D	0.16	0.28	0.23
R-5-E	0.16	0.26	0.26
Single-Family	0.07	0.49	0.13
Townhouse	0.08	0.16	0.10
Multi-Family	0.06	0.25	0.11
All Zones	0.14	0.25	0.12

Data Source: U.S. Census 2000; City of Washington, D.C.

Table 4.5 shows the interaction index calculated for each zoning district. High interaction indices signify that there is much interaction between the two groups. Just as the dissimilarity indices indicated that the R-1-A district had lower levels of segregation, the interaction indices show that there is more interaction between whites and minority groups in the R-1-A district. Part of this phenomenon

could be attributed to higher incomes of minorities within the R-1-A district (Chart 4.8). Also, some of the lowest interaction between whites and minorities occurs in the R-5-A district. Again, this zoning district accommodates the largest minority population, and this index shows that this population is more segregated than minorities in other districts.

The isolation index, shown in Table 4.6, shows the amount to which each group interacts only with themselves. The numbers show that minorities throughout the city are highly isolated, with the R-5-A district being one of the two districts in which minorities are most isolated. Whites are most isolated in the single-family districts and the lowest-density townhouse district (R-3). This white isolation supports the notion that low-density, single-family zoning can result in large areas of white population separated from significant minority populations.

Table 4.7 shows concentration indices calculated for each zoning district. Hispanics are the most concentrated group considered in this table. Whites, however, are on average more concentrated than the minority population. Minorities are least concentrated in townhouse districts.

TABLE 4.6 – Isolation Index

Zoning	Black	Hispanic	Minority	White
R-1-A	0.48	0.09	0.45	0.78
R-1-B	0.83	0.13	0.82	0.78
R-2	0.73	0.14	0.96	0.74
R-3	0.88	0.12	0.88	0.82
R-4	0.81	0.30	0.90	0.59
R-5-A	0.94	0.19	0.96	0.69
R-5-B	0.73	0.37	0.83	0.66
R-5-C	0.49	0.22	0.71	0.56
R-5-D	0.70	0.37	0.77	0.62
R-5-E	0.67	0.44	0.74	0.64
Single-Family	0.88	0.12	0.87	0.77
Townhouse	0.82	0.28	0.90	0.69
Multi-Family	0.87	0.34	0.89	0.66
All Zones	0.72	0.29	0.88	0.70

Data Source: U.S. Census 2000; City of Washington, D.C.

TABLE 4.7– Concentration Index

Zoning	Black	Hispanic	Minority	White
R-1-A	0.51	0.51	0.42	0.42
R-1-B	0.52	0.57	0.45	0.51
R-2	0.32	0.66	0.30	0.73
R-3	0.52	0.51	0.45	0.55
R-4	0.30	0.61	0.30	0.58
R-5-A	0.39	0.66	0.37	0.77
R-5-B	0.44	0.62	0.40	0.55
R-5-C	0.28	0.25	0.17	0.35
R-5-D	0.51	0.65	0.49	0.63
R-5-E	0.59	0.55	0.39	0.34
Single-Family	0.52	0.58	0.47	0.54
Townhouse	0.36	0.59	0.34	0.57
Multi-Family	0.41	0.70	0.38	0.70
All Zones	0.50	0.69	0.48	0.63

Data Source: U.S. Census 2000; City of Washington, D.C.

Theil's index, shown in Table 4.8, provides a good measure of evenness throughout the city and the amount to which each zoning district contributes to the city's unevenness. The index shows that the R-5-A district makes up the biggest share of the city-wide Theil's index. This district, however, has the largest population of any of the city's districts. When accounting

TABLE 4.8– Theil's Index

	Decomposed Index			Standardized by Population		
	Black	Hispanic	White	Black	Hispanic	White
R-1-A	0.02	0.01	0.01	0.57	0.35	0.19
R-1-B	0.07	0.05	0.05	0.62	0.44	0.45
R-2	0.07	0.06	0.07	0.76	0.68	0.78
R-3	0.05	0.03	0.04	0.68	0.38	0.60
R-4	0.09	0.03	0.12	0.40	0.13	0.56
R-5-A	0.17	0.14	0.18	0.74	0.60	0.78
R-5-B	0.05	0.02	0.05	0.44	0.18	0.39
R-5-C	0.00	0.00	0.00	0.21	0.18	0.11
R-5-D	0.03	0.01	0.02	0.42	0.09	0.28
R-5-E	0.01	0.00	0.01	0.54	0.08	0.23
Single-Family	0.16	0.12	0.13	0.67	0.52	0.54
Townhouse	0.14	0.05	0.16	0.47	0.19	0.57
Multi-Family	0.26	0.11	0.25	0.60	0.24	0.57
All	0.57	0.29	0.55	0.57	0.29	0.55

Data Source: U.S. Census 2000; City of Washington, D.C.

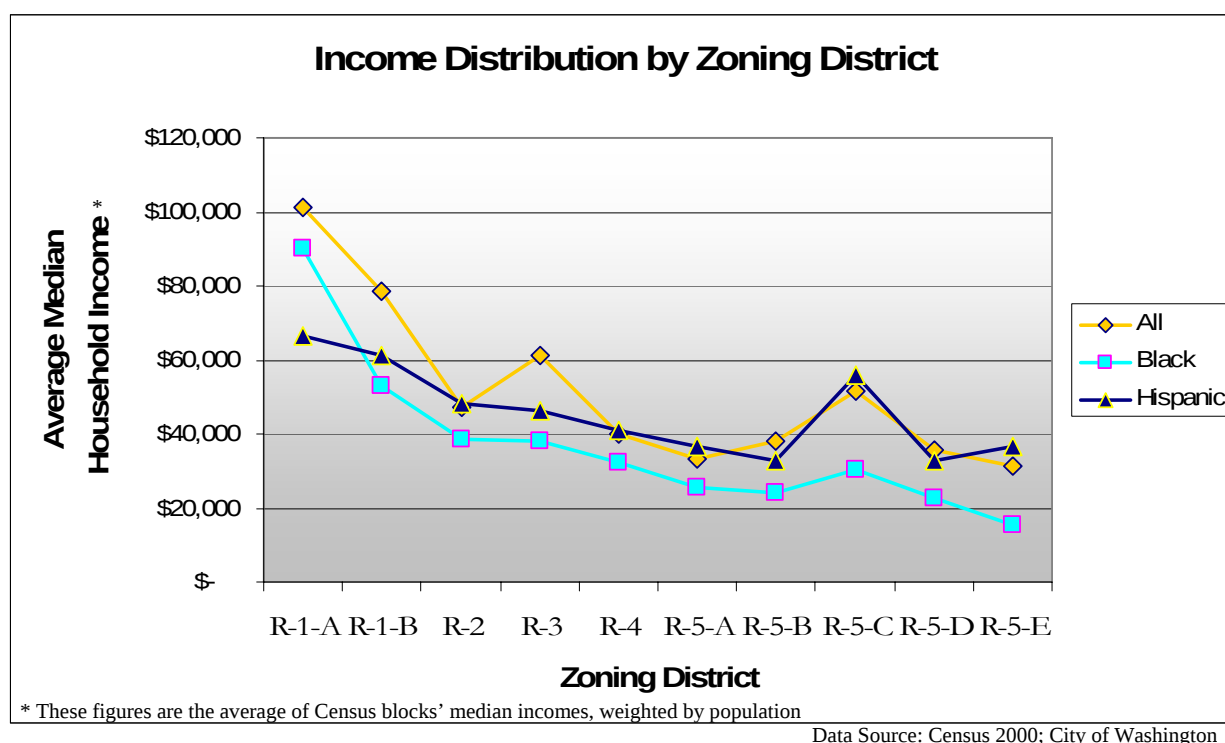
for this large population, the R-5-A district still exhibits some of the highest influences on the city's segregation patterns. Among blacks and Hispanics, both single-family and multi-family districts have high Theil's index numbers. These two zoning types contribute most to black segregation because the single-family districts have many areas lower in black or Hispanic population than the city average, while multi-family districts have many areas higher in black or Hispanic population than the city average. The relatively small index for townhouse districts shows that these areas more frequently have a mixed population.

Income Distribution

This demographic study clearly shows that minorities, particularly blacks, more commonly reside in multi-family zoning districts and are typically less integrated within multi-family districts. The trend, however, is not completely consistent with zoning density. Many low-density districts contain a high proportion of minority residents, and some high-density districts contain a relatively low proportion of minorities. Income distribution, however, is much more consistent with the density permitted by each zoning district. Low-density zoning can limit housing affordability and rental housing and can result in the exclusion of low-income households. As shown by the lack of perfect correlation with racial distribution, zoning does not determine where all minorities reside. High-income minorities do not have the same housing

needs as low-income minorities. The housing types available in particular zoning districts can influence the location of low-income minorities differently than high-income minorities. Consequently, zoning can correlate with income better than race or ethnicity. Chart 4.8 shows that this trend exists in Washington D.C. As zoning district's permitted density increases, average household incomes decline. This correlation is true for the total population, the black population and the Hispanic population with the exception of a few outliers. The outliers seen in the R-5-C district could be due to a small population within the district.

CHART 4.8



Poverty rates roughly follow the same trend seen in the city's income distribution. A higher percent of the population lives under the poverty threshold in multi-family districts than in other zoning districts. Table 4.9 shows that black and Hispanic poverty rates are higher than that of whites in all zoning districts. Blacks, whites and Hispanics all see their poverty rates increase as zoning density increases and as zoning districts permit higher-intensity residential uses. This trend, along with the income distribution shown in Chart 4.8 exemplifies zoning's connection with housing affordability. Naturally, people with lower incomes, especially people living under the poverty threshold require more affordable housing. In Washington, D.C., the low-income population has more success finding this affordable housing in high-density and multi-family

zoning districts. Low-density zoning districts do not necessarily prevent all poor people from residing in these single-family areas, but the percent of people living under the poverty limit are by far the lowest in the low-density districts.

TABLE 4.9		Percent of Population Living Below Poverty Level			
Zoning	All	Black	Hispanic	White	
R-1-A	5%	6%	10%	4%	
R-1-B	9%	11%	12%	5%	
R-2	16%	19%	22%	6%	
R-3	17%	19%	19%	12%	
R-4	19%	24%	19%	5%	
R-5-A	29%	31%	17%	12%	
R-5-B	23%	34%	23%	8%	
R-5-C	25%	33%	32%	7%	
R-5-D	22%	30%	26%	12%	
R-5-E	25%	40%	28%	18%	
Single-Family	11%	15%	14%	5%	
Townhouse	19%	23%	19%	8%	
Multi-Family	26%	32%	23%	10%	
Totals	19%	25%	20%	7%	

Data Source: U.S. Census 2000; City of Washington, D.C.

Proximity to Industrial Zoning

Residential zoning districts are consistent with the racial and ethnic distribution of the city. The location of industrial zoning districts is likely to correspond with minority populations as well. Minorities and low-income residents have been much more likely to be near industrial uses and other uses that endanger the health of nearby residents (Kahn, 2006). Industrial zoning districts have expanded at greater rates in minority and low-income neighborhoods (Maantay, 2001). In Washington, D.C. a high proportion of the population residing near industrial zoning districts belongs to a minority group. Table 4.10 shows that although only 60% of the city's population is black, 70% of the population within 100 meters of an industrial zoning district is black. The overall minority population is also higher in areas near industrial zoning, while the white proportion is lower near industrial areas. The contrast is most apparent in single-family zoning districts. Single-family-zoned Census blocks near industrial land are made up of nearly 80% blacks. This is a very high proportion of blacks, considering that single-family districts are made up of only a 55% black population. Thus, a large amount of blacks that have located in

single-family districts have also located near industrial zoning districts. This proximity to industrial zoning could be bringing down land and housing values enough to enable greater numbers of minorities to reside in these single-family areas.

TABLE 4.10 – Industrial Zoning

Generalized Zoning	Number Blocks	Area (Acres)	Population within 100 meters of industrial zoning								
			Total	Black	%	Hispanic	%	White	%	Minority	%
Single-Family	186	1,282	11,113	8,655	78%	330	3%	1,845	17%	9,268	83%
Townhouse	189	1,502	30,847	19,703	64%	1,691	5%	8,324	27%	22,523	73%
Multi-Family	144	1,755	27,773	20,818	75%	868	3%	5,351	19%	22,422	81%
Commercial	101	416	837	552	66%	209	25%	60	7%	777	93%
Other	345	5,993	2,678	1,317	49%	189	7%	1,046	39%	1,632	61%
Totals	965	10,948	73,248	51,045	70%	3,287	4%	16,626	23%	56,622	77%
Whole City	5,674	43,735	572,059	343,312	60%	44,953	8%	159,178	28%	412,881	72%

Data Source: U.S. Census 2000; City of Washington, D.C.

HOUSING STOCK ANALYSIS

The demographic analysis on Washington, D.C. showed that there are some important connections between the city's racial distribution and its zoning districts. Zoning, however, does not directly affect racial settlement patterns. Zoning's direct impact is seen through the city's housing stock. Zoning regulations can affect the type, availability and density of housing in the city, but its regulations do not govern where certain groups may reside. Only through its effect on the housing stock can zoning influence the city's racial distribution. While the above study showed correlations between zoning and racial distribution, these correlations will only be meaningful if the city's housing supply reflects zoning regulations. If zoning has no effect on the housing stock, it should have no effect on demographics.

The housing stock, however, considerably reflects the regulations set forth by the city's zoning districts. Table 4.11 and Chart 4.9 show the direct correlation between housing density and zoning regulations. As zoning districts permit higher density residential developments, housing density increases. The only real exception is seen in the R-5-D district. Either the R-5-D district is built at a lower density than the maximum density permitted, or there could be more undeveloped, vacant land in the R-5-D district than in other districts. Other than the R-5-D district, zoning regulations are well-represented by the city's housing supply.

TABLE 4.11 – Housing Density

Zoning	Number Blocks	Area (Acres)	Housing Units	Housing Density
R-1-A	186	2,583	8,874	3.4
R-1-B	1,109	6,924	27,507	4.0
R-2	623	3,034	22,463	7.4
R-3	355	1,791	18,304	10.2
R-4	993	4,171	55,903	13.4
R-5-A	642	5,867	61,928	10.6
R-5-B	324	1,787	39,188	21.9
R-5-C	7	37	1,675	44.7
R-5-D	100	861	20,276	23.6
R-5-E	43	148	8,457	57.2
Single-Family	1,918	12,541	58,844	4.7
Townhouse	1,348	5,962	74,207	12.4
Multi-Family	1,116	8,700	131,524	15.1
Totals	4,382	27,203	264,575	9.7

Data Source: U.S. Census 2000; City of Washington, D.C.

Another impact that zoning regulations have on the housing market is through the regulation of housing type. R-1-A, R-1-B and R-2 only permit single-family housing units. R-3 (Figure 4.17) and R-4 permit single-family, duplex and rowhouse/ townhouse developments, while R-5-A through R-5-E permit single-family, townhouse and multi-family (apartment) housing units. Since single-family units are permitted in all zoning districts, it is possible that each zoning district is comprised primarily of single-family units. If this is the case, zoning's impact on housing availability would be smaller and any potential impact on racial distribution should be considered smaller.

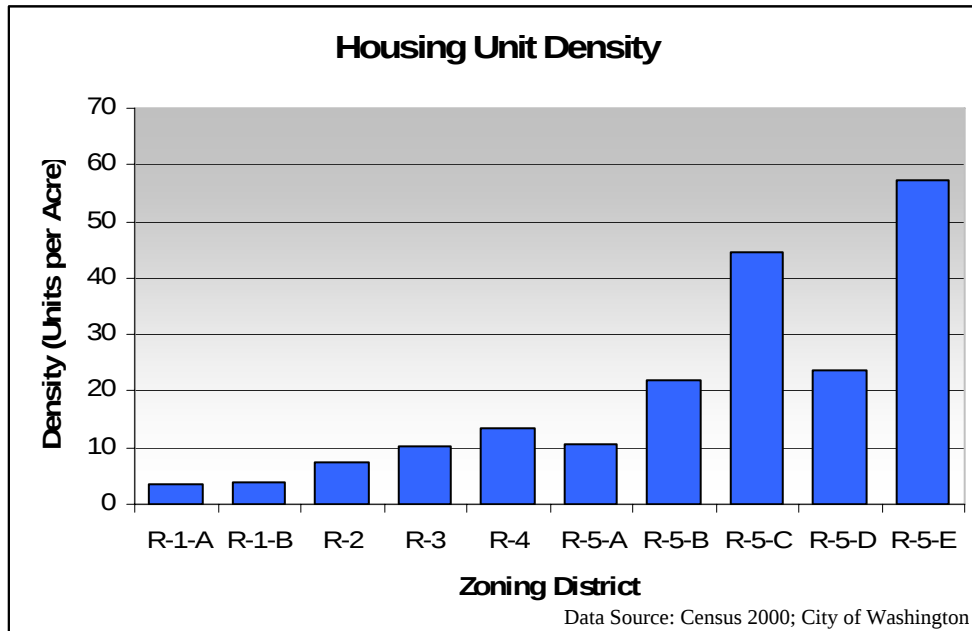
CHART 4.9**FIGURE 4.17 – R-3 Rowhouses**

Table 4.12 displays home-ownership rates in each zoning district and by type of residential unit permitted. The table shows that a higher proportion of people, no matter to which racial or ethnic group they belong, own their home in single-family districts than in townhouse or multi-family districts. Multi-family districts contain the lowest proportion of homeowners. Typically, multi-family developments contain much more rental housing than single-family housing developments (Pendall, 2000). Although single-family homes can be rented, home-ownership rates are typically much higher among single-family housing units than among multi-family units such as apartments. Townhouse developments also typically have higher home-ownership rates than other multi-family housing units. Thus, we can assume that higher home-ownership rates in single-family zoning districts are due to a higher amount of single-family housing units. The lower proportions of homeowners in townhouse and

multi-family districts reflects the abundance of higher-intensity housing units (townhouses, apartments, condominiums, etc.) established in zoning districts where these uses are permitted. Since built housing types also reflects the housing types permitted by each zoning district, we can conclude that zoning regulations are affecting housing type, which could be a contributing factor in racial and ethnic settlement patterns.

TABLE 4.12 – Housing Tenure

Zoning	Total Population	Percent of Population Residing in Household in which Householder Owns Housing Unit				
		All	Black	Hispanic	Minority	White
R-1-A	15,998	66%	77%	42%	65%	67%
R-1-B	62,580	80%	82%	61%	79%	80%
R-2	50,642	73%	74%	59%	73%	76%
R-3	37,956	62%	66%	59%	64%	59%
R-4	115,145	51%	51%	41%	50%	57%
R-5-A	124,197	20%	18%	16%	18%	42%
R-5-B	67,253	24%	17%	16%	17%	38%
R-5-C	2,659	14%	16%	12%	14%	14%
R-5-D	31,875	19%	15%	8%	13%	31%
R-5-E	11,268	17%	12%	9%	11%	23%
Single-Family	129,220	76%	77%	58%	75%	76%
Townhouse	153,101	54%	55%	44%	53%	58%
Multi-Family	237,252	21%	17%	13%	17%	36%
Totals	536,497	44%	42%	28%	40%	54%

Data Source: U.S. Census 2000; City of Washington, D.C.

Although zoning does not directly affect housing vacancy, zoning and other land use regulations can affect the amount of housing available and indirectly impact vacancy rates. Low vacancy rates can drive up housing prices, making housing less affordable (Pendall, 2000). Table 4.13 shows that vacancy rates are quite low in R-1-A and R-1-B. Since these districts are comprised of little rental housing, it is not surprising that vacancy rates are lowest in these districts. The R-5-C and R-5-D districts also have low vacancy rates. These low vacancy rates in districts with abundant rental housing could be raising rents on these rental units, which could help explain why a lower proportion of minorities reside in these districts than in the R-5-A and R-5-B zoning districts. Conversely, the R-4, R-5-A and R-5-B zoning districts have vacancy rates of 10% or higher, which could be leading to a more affordable housing stock within these

zoning districts. These three districts are the zoning districts with the highest total minority populations.

TABLE 4.13 – Housing Vacancy

Zoning	Total Units	%Occupied	%Vacant	%Owner-Occupied	%Renter-Occupied	%Vacant, For Rent	%Vacant, For Sale
R-1-A	8,874	95%	5%	55%	45%	29%	8%
R-1-B	27,507	96%	4%	76%	24%	19%	18%
R-2	22,463	92%	8%	73%	27%	24%	23%
R-3	18,304	92%	8%	61%	39%	28%	17%
R-4	55,903	87%	13%	47%	53%	26%	15%
R-5-A	61,928	88%	12%	22%	78%	51%	5%
R-5-B	39,188	90%	10%	25%	75%	31%	10%
R-5-C	1,675	96%	4%	13%	87%	38%	0%
R-5-D	20,276	95%	5%	21%	79%	47%	6%
R-5-E	8,457	92%	8%	18%	82%	43%	4%
SF	58,844	94%	6%	72%	28%	23%	19%
TH	74,207	88%	12%	51%	49%	27%	15%
MF	131,524	90%	10%	22%	78%	45%	7%
AllZones	274,845	90%	10%	41%	59%	35%	11%

Data Source: U.S. Census 2000; City of Washington, D.C.

SUMMARY

Washington, D.C.’s zoning districts are loosely correlated with the city’s minority population. Single-family districts have a fairly-high minority population proportion (63%), and townhouse and multi-family districts are only slightly higher in minority population (75% and 76%, respectively). This loose correlation shows that zoning may play a small role in determining the city’s racial distribution, but historic, cultural and other factors are most likely having greater impacts on Washington’s racial distribution and segregation patterns.

Washington has a long history, and most of the city had been at least partially developed before the modern zoning ordinance and map were established. Thus, zoning has played a small role in determining the kinds of housing opportunities available. Rather, zoning districts were likely established based on the existing housing stock and has changed based on changing market demand.

Many single-family residential zoning districts have higher minority populations than certain multi-family districts. The high overall black and minority populations in D.C. are contributing to high minority populations in all zoning districts. If zoning played a greater role

in determining the city's racial distribution, however, multi-family districts would have much higher minority populations than single-family districts. Washington has high levels of racial segregation, but this segregation is not completely consistent with zoning districts.

Although there is not an absolute correlation between each of Washington D.C.'s zoning districts and the city's racial distribution, the R-1-A and R-5-A districts provide cases in which zoning density and type is consistent with minority populations and cases in which zoning could be impacting racial distribution and segregation. The R-1-A zoning district has the lowest proportion of minorities. The low-density nature of this district prevents the kind of dwelling units (affordable, multi-family units, rental units) in which minorities more often reside. Within the R-1-A district, many Census blocks have almost no black population. Low-density zoning regulations could be an influencing factor in keeping low-income blacks out of these neighborhoods. This district's consistency with income segregation is more apparent. The median black household income in the R-1-A district is higher than that of any other zoning district, indicating that most minorities that locate in the district are wealthier than other minorities in the city. The R-1-A district comprises less than 10% of Washington's residentially-zoned land and less than 4% of the city's population. While this district's density corresponds with racial and ethnic settlement patterns, the district's small size makes R-1-A's low minority population have a small contribution to the city's overall racial distribution.

The R-5-A district contains the highest proportion and the highest number of minorities. This multi-family district better accommodates the housing needs of most minorities. The R-5-A district provides a great deal of residential land in which black and minority clustering occurs. Most Census blocks within the R-5-A district have minority populations over 90%. This district provides an abundance of multi-family housing in the eastern portion of the city. Since the eastern half of the city is made up of mostly minorities, it is not surprising that more minorities reside in this district.

Other multi-family districts have relatively low minority populations, which shows little correlation with zoning district density. These districts, however, exhibit high consistency with income distribution. The population within multi-family zoning districts has lower median incomes than the total population, and minorities within multi-family zoning districts have lower incomes than minorities residing in single-family districts. Low-income minorities have more frequently resorted to living within a high-density multi-family zoning district. Many of these

zoning districts are contiguous across large areas and have many clusters of minorities with low median incomes.

CHAPTER 5: ALEXANDRIA, VA

Unlike Washington, D.C., Alexandria’s white population outnumbers its minority population. Alexandria is located just south of Washington, adjacent to a small portion of Washington’s southern edge. Alexandria had a 2000 population of 128,283. Although Alexandria does not contain as large a black population as D.C., the city nonetheless contains a great deal of diversity. Alexandria’s population is 23% black and 15% Hispanic. Overall, minorities comprise about 41% of the city’s population. This chapter analyzes Alexandria’s racial and ethnic distribution and its correlation with zoning.

ZONING ORDINANCE AND MAP

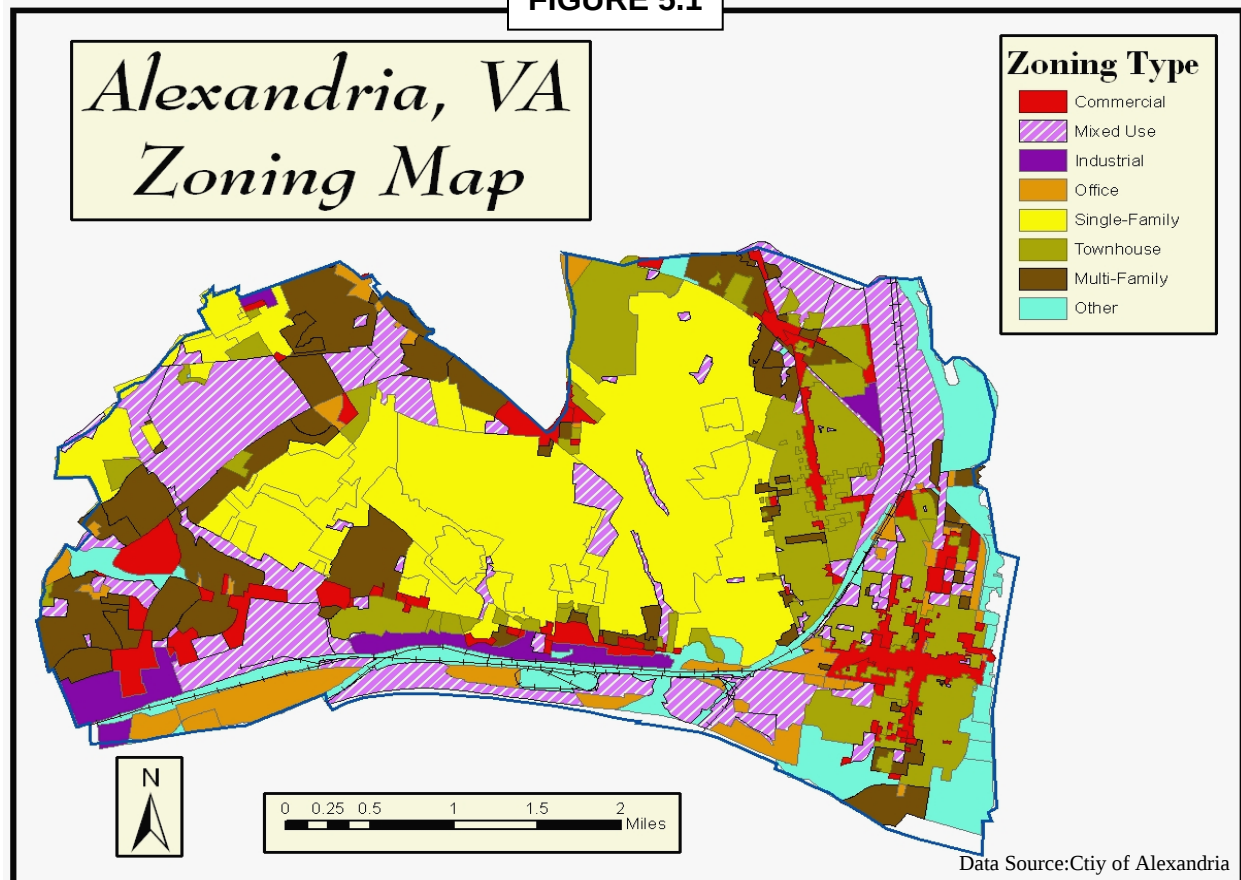
Alexandria’s zoning districts (shown in Table 5.1) include 13 residential districts, 7 commercial districts, 4 office districts, 2 industrial districts, 6 mixed-use districts and 2 other zoning districts. Alexandria’s zoning ordinance is an exclusive ordinance – each zoning district has a unique set of permitted uses not necessarily dependent on the uses permitted by lower-intensity zoning districts. The residential districts are broken down into 5 single-family districts (R20, R12, R8, R5 and R2-5), 4 townhouse districts (RT, RS, RB and RM), and 4 multi-family districts (RA, RCX, RC and RD). Of the single-family districts, only R2-5 allows something other than single-family detached homes. Two of the townhouse districts, RM and RB, permit

TABLE 5.1 – Alexandria, VA Zoning Districts

Density	Residential			Other		
	District	Description	District	Description	District	Description
Low	R20	Single-Family Detached	CL	Commercial	CRMU-L	Mixed
	R12	Single-Family Detached	CC	Commercial	CRMU-M	Mixed
	R8	Single-Family Detached	CSL	Commercial	CRMU-H	Mixed
	R5	Single-Family Detached	CG	Commercial	CRMU-X	Mixed
	RT	Townhouse	CD	Commercial	W-1	Mixed
	RS	Townhouse	CD-X	Commercial	CDD	Mixed
	R2-5	Single-Family/ Duplex	CR	Commercial	POS	Public
	RB	Townhouse	OC	Office	WPR	Waterfront Recreation
	RA	Multi-Family	OCM(50)	Office		
	RM	Townhouse	OCM(100)	Office		
	RCX	Multi-Family	OCH	Office		
	RC	Multi-Family	I	Industrial		
	RD	Multi-Family	UT	Industrial		
High						

Source: City of Alexandria

FIGURE 5.1



single-family detached uses as well as townhouses. Of the multi-family districts, only RA permits single-family dwellings. RA, RC and RCX permit townhouses along with multi-family dwellings. All of the mixed-use zoning districts permit single-family, townhouse and multi-family dwellings.

Alexandria's zoning map (shown in generalized form in Figure 5.1) shows a high concentration of single-family zoning in the geographic center of the city, with a good deal of townhouse and commercial zoning in the city's eastern third (includes downtown Alexandria), and large quantities of multi-family and mixed-use zoning in the western portions of the city.

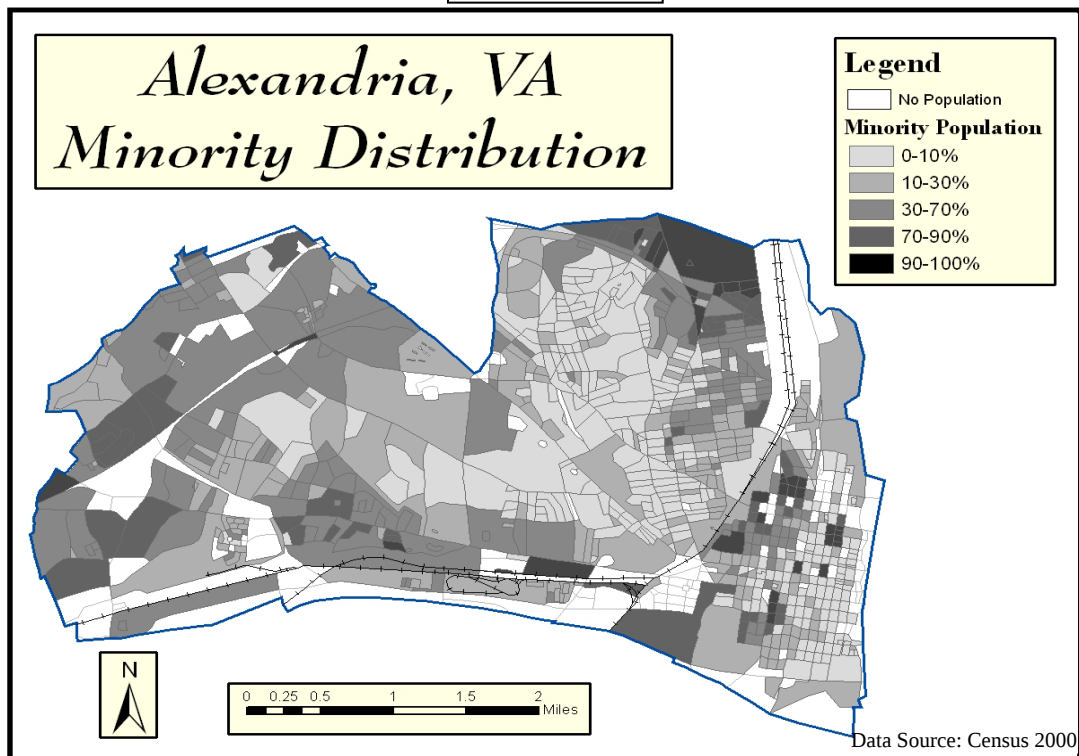
RACIAL/ ETHNIC DISTRIBUTION

Visual Analysis

Alexandria has an overall smaller minority population than D.C., and this minority population is more evenly distributed throughout the city than Washington's minority population. While D.C.'s minorities clustered to a large extent in the eastern half of the city,

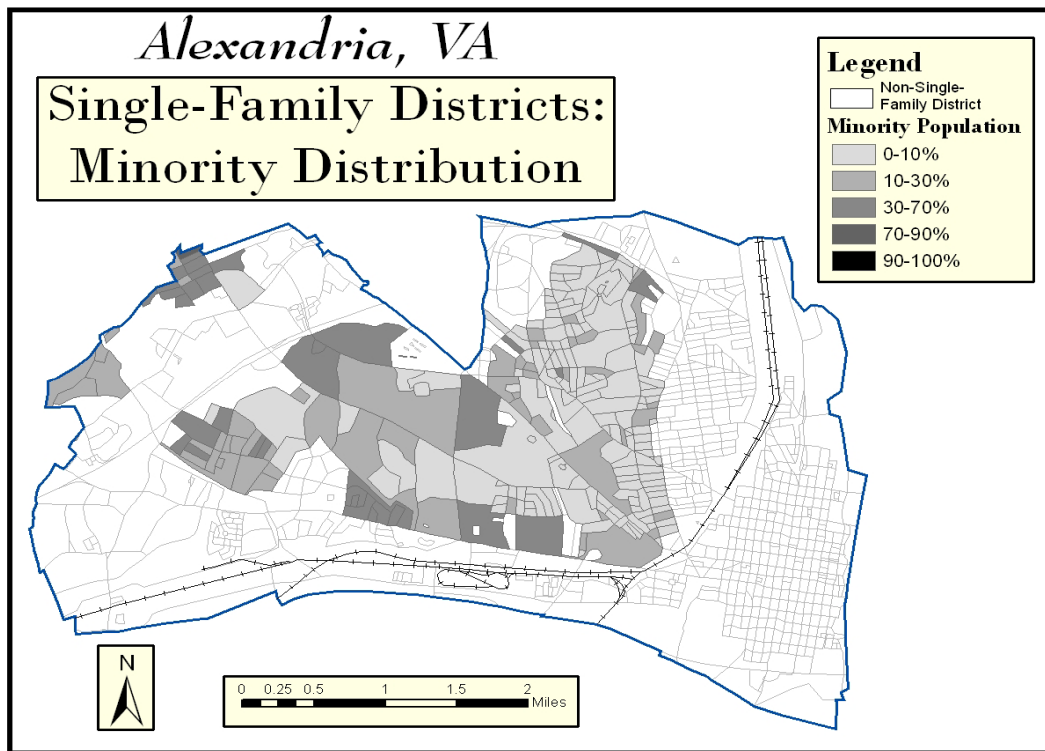
Alexandria, as shown in Figure 5.2, has areas of high minority population in the northern, southern, eastern and western portions of the city. Although there are areas low in minority population, such as the central portion of the city, and areas high in minority population, these contrasting areas do not dominate entire sections of the city.

FIGURE 5.2



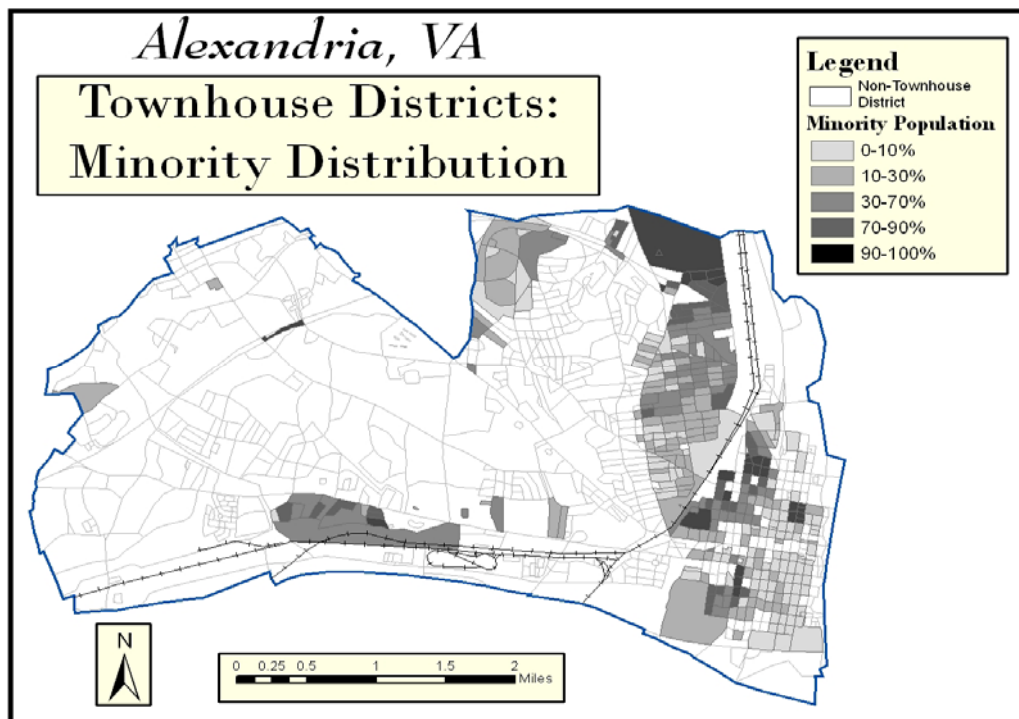
Although the racial division of the city is not as severe as in D.C., the minority population is not widely integrated. Figures 5.3, 5.4 and 5.5 show the racial distribution by type of zoning district. The maps show that racial distribution is fairly consistent with zoning type because single-family districts have few areas with a substantial minority population. Townhouse and multi-family districts, on the other hand, contain far more Census blocks with a high minority proportion.

FIGURE 5.3

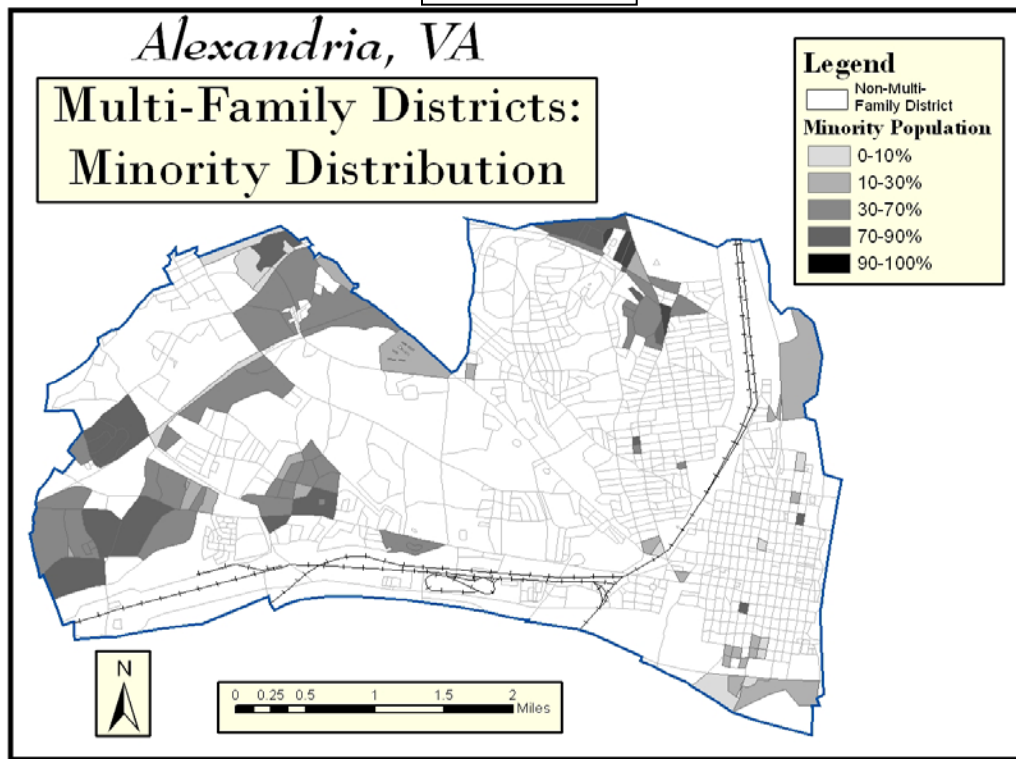


Data Source: City of Alexandria; US Census 2000

FIGURE 5.4



Data Source: City of Alexandria; US Census 2000

FIGURE 5.5

Data Source: City of Alexandria; US Census 2000

As expected, the largest degree of white clustering (Figure 5.6) occurs within single-family zoning districts. There are, however, areas of white clustering in townhouse and other zoning districts as well. Most of the blue areas in the white clustering map (areas low in white population and neighboring areas low in white population) are located in mixed use, townhouse or multi-family zoning districts. Conversely, black and minority clustering, shown in figures 5.7 and 5.8, mainly occur in areas other than single-family-zoned areas. There are large black and Hispanic clusters in the northeastern portion of the city. This area is dominated by mixed-use, multi-family, and townhouse districts. All of these districts permit a wider variety of housing types and allow greater housing densities than permitted in the city's single-family districts. The fact that clustering occurs within these districts highlights minorities' needs for a variety of housing types built at densities that can make these housing units more affordable.

FIGURE 5.6 – White Clustering

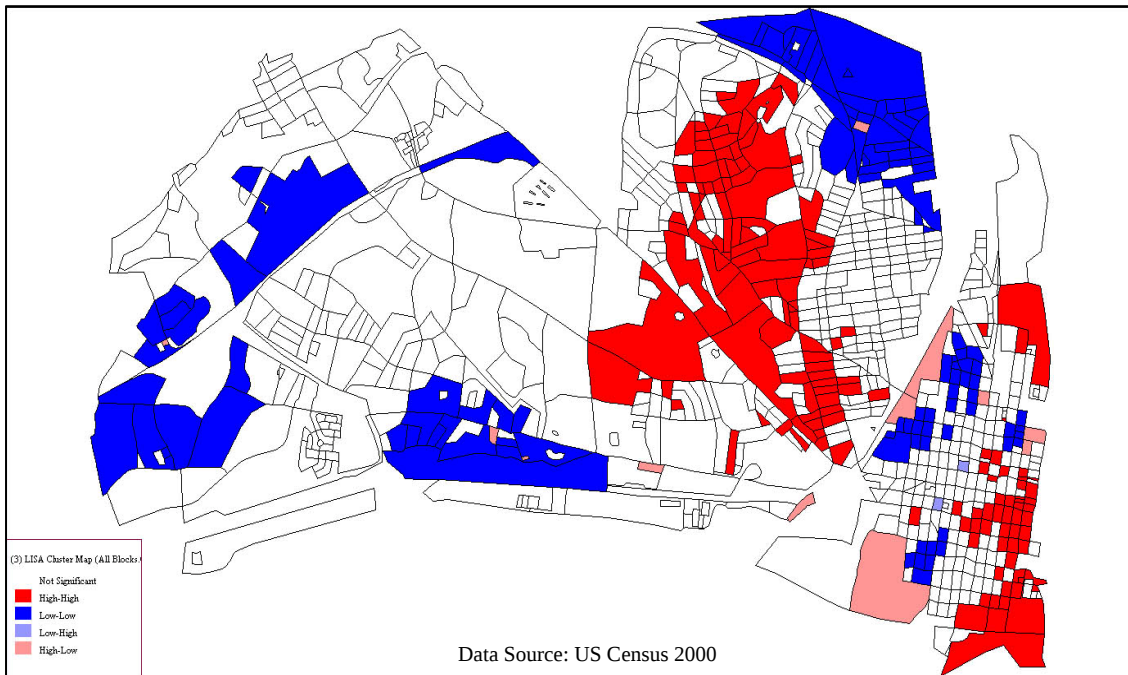
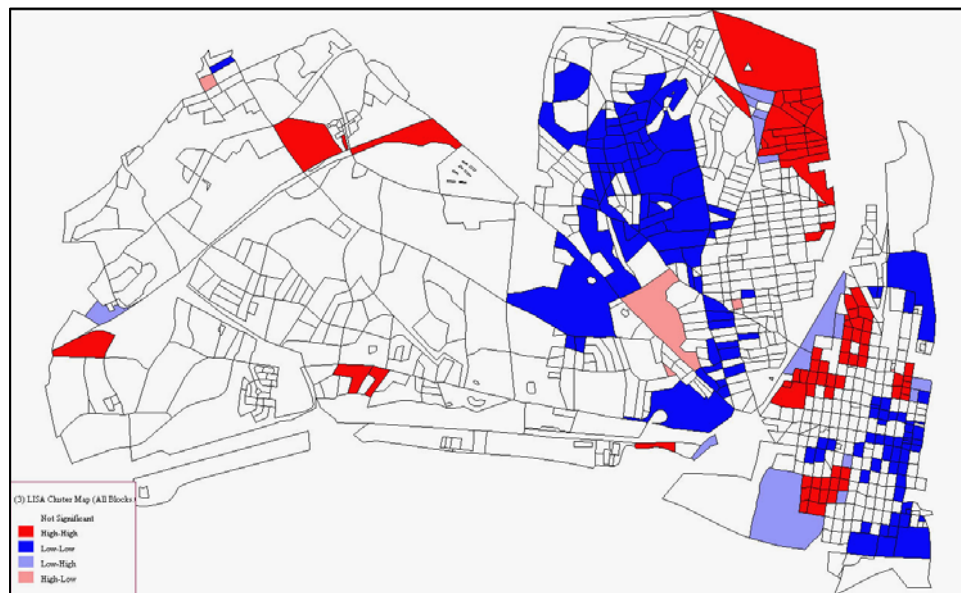
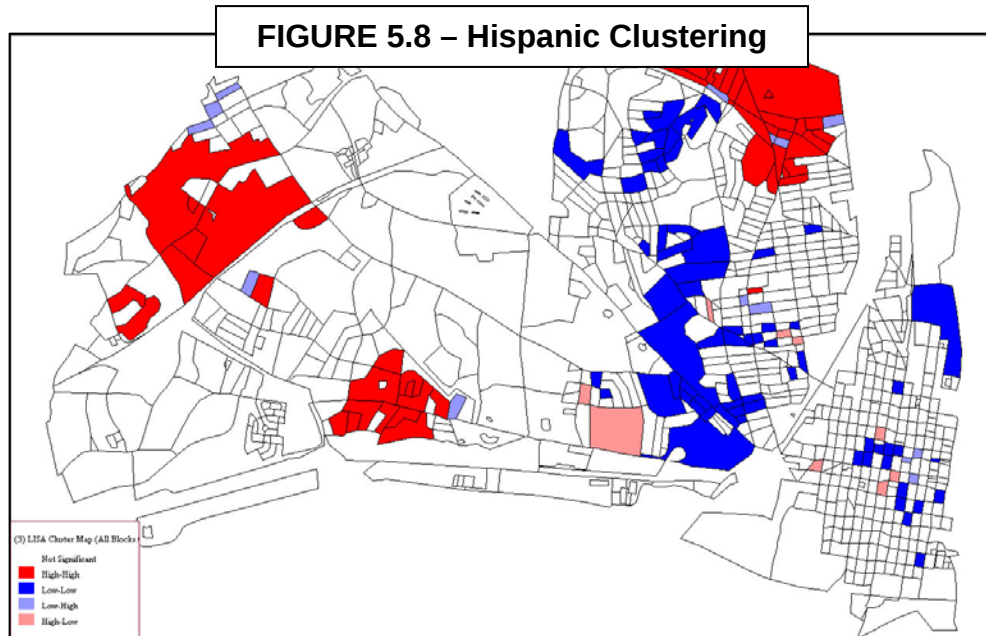


FIGURE 5.7 – Black Clustering





Data Source: US Census 2000

Quantitative Analysis

Although this visual analysis confirms zoning's correlation with racial distribution, population figures need to be analyzed to assure that these trends are supported numerically. Table 5.2 shows the total population by race/ ethnicity in each zoning district. The minority population is highest in the RB, RA and RC zoning districts, all of which allow townhouses or multi-family units. The white population is also high in these zoning districts, but the R8 (single-family) district also contains a large number of whites. The highest numbers of Hispanics reside in the RA district, but the highest numbers of blacks reside in the RC district. Both of these are multi-family zoning districts, but the RC district permits higher densities.

When looking at type of zoning district (Table 5.3), minority distribution is as expected – the highest numbers of minorities reside in multi-family districts, and the fewest minorities live in single-family districts. The white population also increases as zoning districts permit higher-intensity uses, but the increase among the white population is much smaller than that of the minority population. The white population is nearly four times the minority population in single-family districts. In townhouse districts, the white population is less than two times the minority population, while in multi-family districts, the minority population actually outnumbers the white population.

TABLE 5.2 – Racial Composition of Zoning Districts

Density	Zoning	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population
Low	R20	27	709	2,621	266	123	2,127	576
	R12	30	576	3,085	192	391	2,491	715
	R8	144	1,526	14,654	1,871	1,214	11,258	3,999
	R5	61	321	3,518	170	183	3,144	481
	RT	3	34	508	41	36	404	122
	R2-5	122	648	8,069	2,017	836	5,061	3,351
	RB	141	1,019	15,865	5,602	2,216	8,306	8,378
	RA	65	944	26,319	6,596	7,741	12,141	16,811
	RM	106	348	6,300	662	181	5,385	1,039
	RCX	10	136	5,809	1,670	1,260	2,487	3,922
	RC	36	710	27,741	7,161	2,743	15,174	13,987
High	RD	1	3	116	2	8	106	18
	Totals	824	8,044	128,283	28,915	18,882	76,702	59,394

Data Source: U.S. Census 2000; City of Alexandria

TABLE 5.3 – Racial Composition by Zoning Type

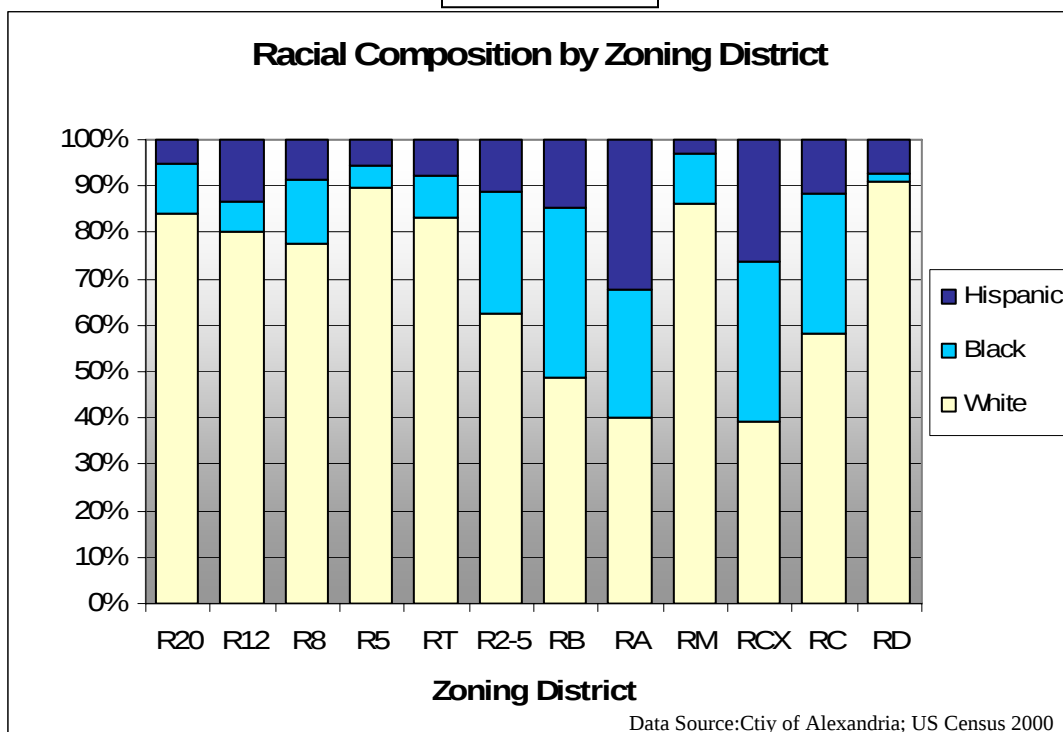
Zoning Type	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population	Percent Minority
Single-Family	248	3,083	23,878	2,499	1,911	19,020	5,771	24%
Townhouse	355	1,957	30,742	8,322	3,269	19,156	12,890	42%
Multi-Family	98	1,692	59,985	15,429	11,752	29,908	34,738	58%
Residential								
Totals	701	6,733	114,605	26,250	16,932	68,084	53,399	47%

Data Source: U.S. Census 2000; City of Alexandria

Chart 5.1 shows the proportion of whites, blacks and Hispanics living in each zoning district. Other than the RM and the RD district, there is a trend that as zoning districts permit higher densities, a larger proportion of minorities reside within the district. The high white population in the RD district is not necessarily explanatory of zoning's correlation with racial distribution. Only one Census block was assigned to the RD zoning district, and only 116 people reside within that block. Thus, the RD district has a miniscule population that does not necessarily reflect what actual settlement patterns would be in this high-density district if it were more widespread. The RM district, however, does have a substantial population. Although this district permits high densities, the district does not permit multi-family dwelling units. This district is Alexandria's highest-density townhouse district. The fact that multi-family units are prohibited could be an influencing factor in the district's high white population. The lack of

multi-family units, however, cannot explain the entire phenomenon because other townhouse districts, particularly the RB district, contain high minority populations. This anomaly shows that zoning type and density is not always consistent with minority populations.

CHART 5.1

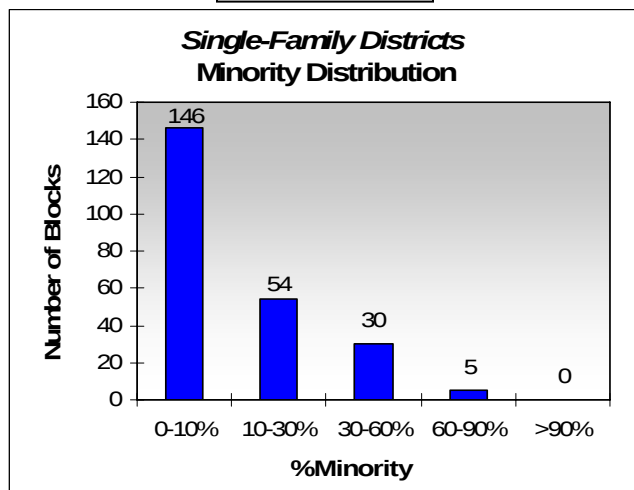


Segregation Trends

Single-family districts (Chart 5.2) are dominated by Census blocks of a small minority population, but when minorities reside in these districts, they are integrated with the white population. Only 5 Census blocks have minority populations over 60% and no Census blocks have a minority population greater than 90%. Townhouse/ duplex districts (Chart 5.3) also have a moderately-integrated minority population. The majority of Census blocks fall between 10% and 90% minority, but there is some lack of integration that occurs in these districts – many blocks have a minority population of less than 10% or greater than 90%. Multi-family districts (Chart 5.4) show a highly-integrated minority population. The peak of this histogram falls in the middle class (30-70% minority). Multi-family districts have few Census blocks in the extreme classes (less than 10%/ greater than 90%). While multi-family districts have higher minority populations, they do not contain large areas of minority segregation. Single-family districts have

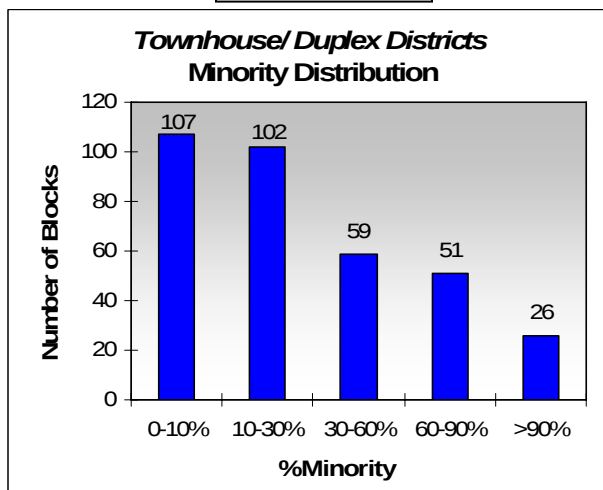
many Census blocks with low minority populations, but the lack of minorities in these zoning districts has not translated into high levels of minority segregation elsewhere in the city.

CHART 5.2



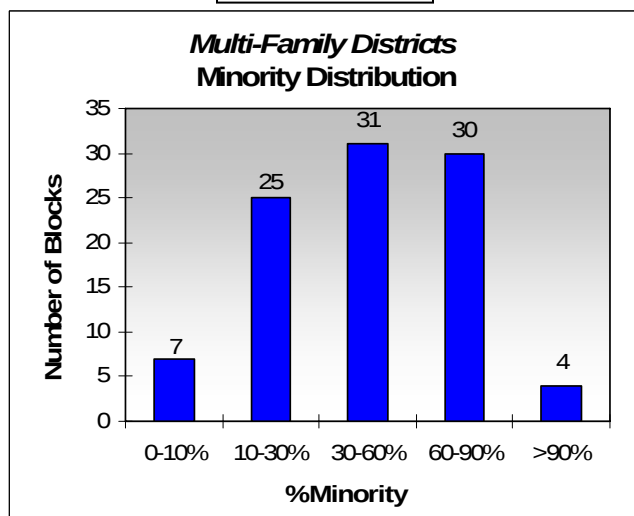
Data Source:Ctiy of Alexandria; US Census 2000

CHART 5.3



Data Source:Ctiy of Alexandria; US Census 2000

CHART 5.4



Data Source:Ctiy of Alexandria; Census 2000

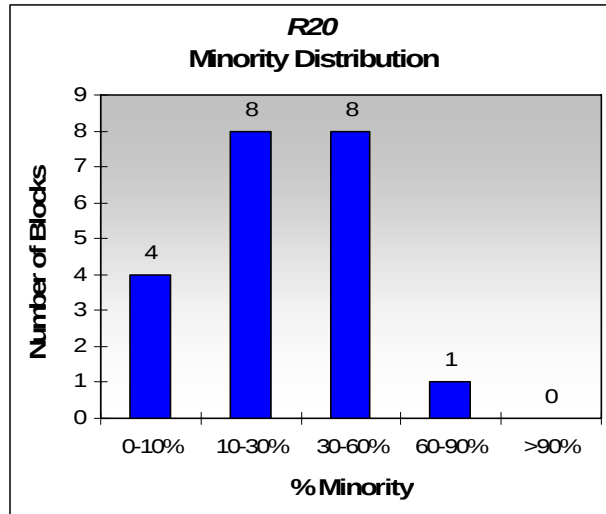
Alexandria's permitted densities in zoning districts have a less dramatic correlation with racial distribution patterns than seen with zoning type. Charts 5.5 and 5.6 show minority distribution within the low-density R20 district and the higher-density R5 district. Based on housing affordability issues, the R20 district's low densities should better protect white neighborhoods from minority integration than the R5 district. By looking at the

distributions, however, it is clear that the R5 district has far fewer blocks with a moderate minority population.

Segregation trends across zoning districts are further analyzed through segregation indices. First, the dissimilarity index, shown in Table 5.4, shows that the black, Hispanic and overall minority populations are much less integrated in single-family and townhouse districts

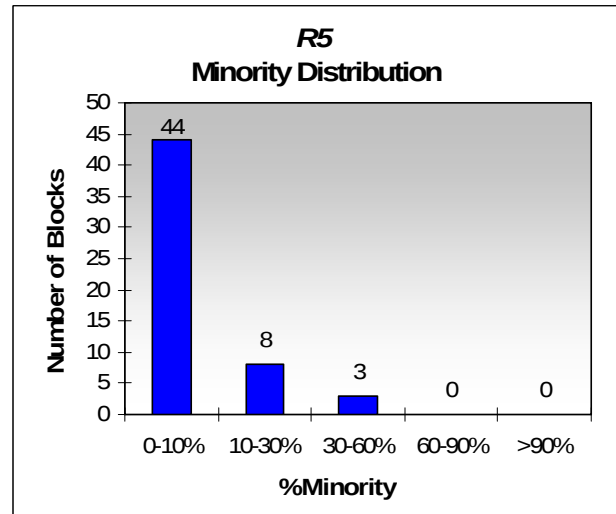
than in multi-family districts. Data discussed previously has shown that single-family districts in Alexandria do not accommodate large minority populations. These dissimilarity index figures

CHART 5.5



Data Source: City of Alexandria; US Census 2000

CHART 5.6



Data Source: City of Alexandria; US Census 2000

TABLE 5.4 – Dissimilarity Index

Zoning	Black-- Non-black	Hispanic-- Non-Hispanic	White-- Non-white	Minority-- Non-Minority
R-20	0.451	0.391	0.344	0.353
R12	0.643	0.640	0.555	0.564
R8	0.549	0.527	0.529	0.553
R5	0.561	0.525	0.520	0.495
RT	0.103	0.027	0.070	0.038
R2-5	0.405	0.471	0.461	0.481
RB	0.545	0.542	0.584	0.618
RA	0.222	0.404	0.309	0.424
RM	0.779	0.469	0.643	0.610
RCX	0.168	0.152	0.271	0.352
RC	0.276	0.210	0.334	0.351
Single-Family	0.567	0.547	0.525	0.536
Townhouse	0.569	0.537	0.594	0.615
Multi-Family	0.249	0.420	0.328	0.396
Entire City	0.398	0.475	0.474	0.519

Data Source: U.S. Census 2000; City of Alexandria

TABLE 5.5 – Interaction Index

Zoning	Black-White	Hispanic-White	Minority-White
R-20	0.715	0.641	0.689
R12	0.451	0.450	0.509
R8	0.479	0.489	0.506
R5	0.673	0.654	0.686
RT	0.752	0.761	0.761
R2-5	0.425	0.383	0.420
RB	0.237	0.243	0.260
RA	0.327	0.215	0.279
RM	0.222	0.599	0.396
RCX	0.244	0.247	0.249
RC	0.406	0.420	0.420
CDD	0.346	0.350	0.359
CRMU	0.786	0.842	0.815
Single-Family	0.515	0.507	0.540
Townhouse	0.284	0.304	0.317
Multi-Family	0.355	0.267	0.332
Entire City	0.350	0.310	0.356

Data Source: U.S. Census 2000; City of Alexandria

show that those minority members that are able to reside in single-family districts are more segregated than minorities living in multi-family districts. The RM district shows the least degree of integration among blacks, minorities and whites. As discussed earlier, this district has a large white population. These indices show that the white population within this district is fairly segregated from the minority population. The interaction index (Table 5.5) and the isolation index (Table 5.6) reinforce the fact that whites within the RM district are fairly isolated from the minority population. The isolation index shows that whites are highly isolated in single-family

districts, but not to the same extent as in the RM district. Blacks, however, show higher degrees

TABLE 5.6 – Isolation Index

Zoning	Black	Hispanic	White	Minority
R-20	0.194	0.148	0.829	0.311
R12	0.181	0.358	0.862	0.491
R8	0.273	0.178	0.827	0.494
R5	0.153	0.179	0.916	0.314
RT	0.093	0.071	0.797	0.243
R2-5	0.394	0.242	0.723	0.580
RB	0.592	0.355	0.716	0.740
RA	0.295	0.471	0.536	0.721
RM	0.674	0.086	0.933	0.604
RCX	0.327	0.243	0.516	0.751
RC	0.322	0.128	0.609	0.580
CDD	0.323	0.241	0.626	0.641
CRMU	0.105	0.058	0.893	0.185
Single-Family	0.249	0.213	0.846	0.460
Townhouse	0.548	0.308	0.781	0.683
Multi-Family	0.311	0.366	0.573	0.668
Entire City	0.375	0.327	0.709	0.644

Data Source: U.S. Census 2000; City of Alexandria

of interaction with the white population and lesser degrees of isolation within low-density single-family districts. Blacks are more isolated and interact less in townhouse and multi-family districts. Hispanics follow this same trend of showing more interaction and less isolation within single-family zoning districts. The concentration index (Table 5.7) shows that minorities across all zoning districts are more concentrated than whites. Minority concentration is highest in the RM district but is also high in the single-family districts. White concentration is

much lower in single-family districts.

This trend shows that not only are single-family districts accommodating a more isolated white population, but these whites also occupy a greater amount of land than minorities within the same districts.

Proximity to Industrial Zoning

While single-family districts contain several isolated white neighborhoods, the area surrounding industrial districts (Table 5.8) are more commonly comprised of a higher minority population. Black, Hispanic, and the overall minority populations are higher

near industrial zones than they are throughout the entire city. Although fewer whites reside near industrial districts than the average number of whites in the city, a substantial amount of whites, particularly in single-family and townhouse districts live near industrial zoning.

TABLE 5.7 – Concentration Index

Zoning	Black	Hispanic	White	Minority
R-20	0.610	0.549	0.230	0.520
R12	0.656	0.586	0.282	0.482
R8	0.647	0.663	0.173	0.591
R5	0.562	0.555	0.179	0.464
RT	0.087	0.110	0.097	0.058
R2-5	0.470	0.564	0.279	0.451
RB	0.510	0.509	0.354	0.413
RA	0.287	0.414	0.218	0.294
RM	0.767	0.540	0.253	0.598
RCX	0.168	0.167	0.108	0.162
RC	0.415	0.401	0.219	0.385
CDD	0.385	0.509	0.383	0.437
CRMU	0.350	0.357	0.382	0.291
Single-Family	0.644	0.635	0.248	0.551
Townhouse	0.528	0.546	0.311	0.469
Multi-Family	0.336	0.412	0.238	0.327
Entire City	0.584	0.611	0.347	0.566

Data Source: U.S. Census 2000; City of Alexandria

TABLE 5.8

Census Blocks within 100 Meters of Industrial Zoning

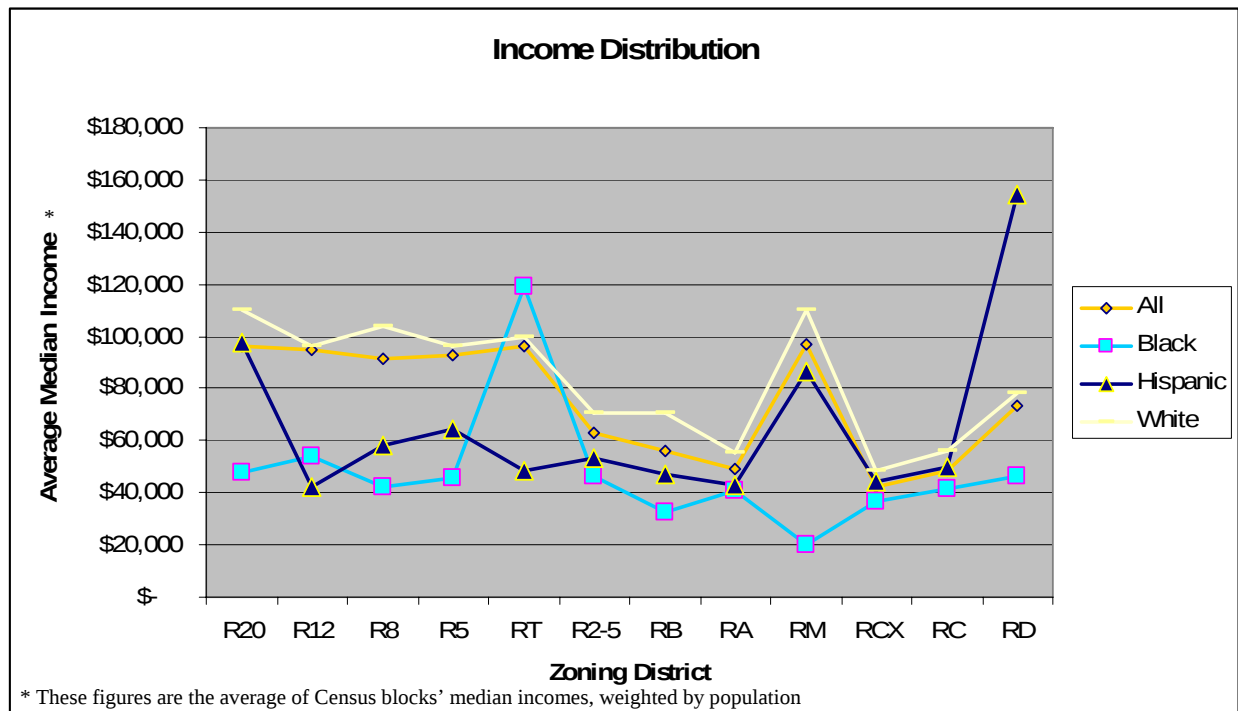
Zoning	Blocks	Area (Acres)	Total Population	Black Population		Hispanic Population		Minority Population		White Population	
				Total	%	Total	%	Total	%	Total	%
Single-Family	17	374	4,174	632	15%	388	9%	1,299	31%	2,875	69%
Townhouse	67	688	8,181	2,768	34%	875	11%	4,126	50%	4,055	50%
Multi-Family	33	686	23,404	6,707	29%	5,203	22%	14,843	63%	8,561	37%
Totals	159	2,668	43,204	11,624	27%	7,477	17%	23,572	55%	19,632	45%
City-Wide	824	8,044	128,283	28,915	23%	18,882	15%	59,394	46%	68,889	54%

Data Source: U.S. Census 2000; City of Alexandria

Income Distribution

While Alexandria's racial distribution is highly correlated with its zoning districts, the city's income distribution is less clear. Chart 5.7 shows that other than the RM and RT district, the overall population's and the white population's median income slightly decline with increases in zoning density. The RM and RT districts also had higher than expected white

CHART 5.7



Data Source: City of Alexandria; US Census 2000

TABLE 5.9 – Poverty Rates

Zoning	Number Blocks	Percent of Population Living Below Poverty Level			
		All	Black	Hispanic	White
R20	21	3%	9%	0%	2%
R12	27	5%	15%	11%	2%
R8	140	2%	6%	11%	1%
R5	60	3%	8%	15%	2%
RT	3	6%	16%	0%	3%
R2-5	117	5%	13%	5%	2%
RA	56	13%	18%	22%	5%
RM	104	8%	43%	17%	3%
RB	131	11%	20%	22%	4%
RCX	10	9%	20%	6%	7%
RC	31	11%	15%	12%	5%
RD	1	13%	65%	0%	6%
CDD	52	5%	10%	4%	3%
Single-Family	248	3%	9%	11%	2%
Townhouse	355	8%	20%	17%	3%
Multi-Family	98	12%	17%	20%	5%
Totals	824	7%	19%	16%	3%

Data Source: U.S. Census 2000; City of Alexandria

populations. These zoning districts appear to be more affluent despite higher permitted densities that enable more affordable housing opportunities. Black and Hispanic incomes do not have a consistent trend across zoning district density. However, poverty levels (Table 5.9) are consistent with the type of residential dwelling unit permitted in each district. They are highest in multi-family districts and lowest in single-family districts.

HOUSING STOCK ANALYSIS

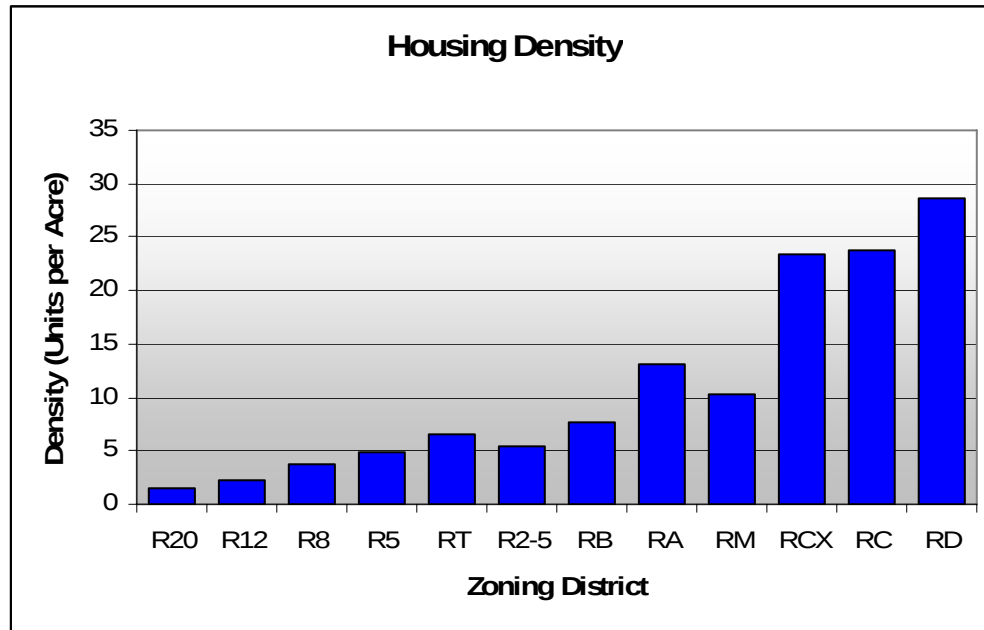
One reason the RM district is exhibiting such high and highly-isolated white populations could be due to a housing stock that is not consistent with the densities and housing types permitted by the district regulations. When looking at housing density shown in Table 5.10 and Chart 5.8, we can see that, with the exception of the RM district, housing density increases with density permitted by zoning districts. The low proportion of minorities within single-family districts is consistent with the low-

TABLE 5.10 – Housing Density

Zoning	Blocks	Area (Acres)	Housing Units	Housing Density
R20	27	709	1,060	1.5
R12	30	576	1,292	2.2
R8	144	1,526	5,828	3.8
R5	61	321	1,546	4.8
RT	3	34	227	6.6
R2-5	122	648	3,539	5.5
RB	141	1,019	7,727	7.6
RA	65	944	12,365	13.1
RM	106	348	3,570	10.2
RCX	10	136	3,160	23.3
RC	36	710	16,921	23.8
RD	1	3	88	28.7
Single-Family	248	3,083	9,726	3.2
Townhouse	355	1,957	15,063	7.7
Multi-Family	98	1,692	32,534	19.2
Totals	824	8,044	64,246	8.0

Data Source: U.S. Census 2000; City of Alexandria

density housing available within these districts. The RM district has somewhat lower densities than the RA district, which does not permit as great a density as permitted by the RM district. This lower density in the RM district could be contributing to the higher than expected white population within this zoning district.

CHART 5.8

Data Source: City of Alexandria; US Census 2000

Alexandria's zoning district is not cumulative but exclusive, meaning that higher-intensity zoning districts such as multi-family districts do not necessarily permit all the uses of lower-intensity districts such as single-family housing units. Due to the exclusive nature of Alexandria's zoning districts, there is much less doubt as to whether housing type reflects the highest-intensity type of housing permitted in each district. In most cases, the highest-intensity housing type is the only housing type permitted in the district. Ownership rates shown in Table 5.11 are consistent with what you would expect for each housing type – highest in single-family districts and lowest in multi-family districts. Table 5.11 also shows that vacancy rates are low in all types of zoning district. The only districts with vacancy rates greater than 5% are the R12 and RCX district. The RCX district also has the highest proportion of minorities of any district within the city. The high vacancy rate in this district could be influencing greater housing affordability and consequently influencing a higher number of minorities to locate there.

TABLE 5.11 – Housing Tenure and Vacancy

Zoning	Housing Units	Occupied	Vacant	Owner- Occupied	Renter- Occupied	Vacant - For Sale	Vacant - For Rent
R20	1,060	97%	3%	78%	22%	22%	4%
R12	1,292	89%	11%	68%	32%	2%	68%
R8	5,828	98%	2%	68%	32%	23%	21%
R5	1,546	98%	2%	73%	27%	24%	27%
RT	227	99%	1%	85%	15%	0%	0%
R2-5	3,539	97%	3%	68%	32%	27%	18%
RB	7,727	97%	3%	48%	52%	14%	33%
RA	12,365	97%	3%	18%	82%	6%	63%
RM	3,570	96%	4%	66%	34%	13%	21%
RCX	3,160	89%	11%	6%	94%	0%	43%
RC	16,921	97%	3%	28%	72%	12%	33%
RD	88	97%	3%	56%	44%	0%	0%
Single-Family	9,726	97%	3%	70%	30%	13%	43%
Townhouse	15,063	97%	3%	58%	42%	16%	26%
Multi-Family	32,534	96%	4%	22%	78%	7%	44%
Totals	64,246	96%	4%	40%	60%	10%	39%

Data Source: U.S. Census 2000; City of Alexandria

SUMMARY

Racial and ethnic distribution is mostly consistent with permitted residential density and even more consistent with actual housing density. Correlations are more consistent across types of zoning districts. Minority populations are higher in multi-family zones than in single-family zones, but minority populations are not necessarily higher in high-density single-family zoning districts than low-density single-family districts.

Alexandria's minority population is not largely constricted to one side of the city as was the case in D.C. Rather, pockets of minority clustering occur at different locations throughout the city. This clustering is not completely consistent with zoning type and zoning density, but a majority of this clustering occurs in higher-density zoning districts, particularly multi-family zoning districts. The availability of multi-family and townhouse zoning in Alexandria has made Alexandria a suburb with diverse housing options. Alexandria offers a wide variety of zoning types, each of which covers a large area of the city's land. Whites are more isolated from

minorities in single-family districts, but a large degree of interaction occurs between whites and minorities in townhouse (other than the RM district) and multi-family districts.

The RM district has one of the highest white proportions of any zoning district in the city. This townhouse district has a lower housing density than is permitted, but the density is still higher than that found in single-family districts. The high white population within this district shows that zoning is not always consistent with the location of predominately white or minority neighborhoods. Although this district permits fairly-high densities and high-intensity residential uses, the white population within this district has been able to remain fairly isolated from the minority population.

CHAPTER 6: FREDERICK, MD

Although Frederick is located within the Washington, D.C. MSA, the city is quite distant from Washington, D.C. and is more of an independent city than a suburb of D.C. Population density maps of the D.C. MSA (Figure 2.3) show that Frederick's density is much higher than any of the places in its vicinity, including places that are physically closer to Washington.

With a 2000 population of 52,843, Frederick claims to be Maryland's second largest city behind Baltimore (Randall, 2007). Frederick has a much smaller minority population than the other locations within my study area. Only 13,199 minorities resided in Frederick in 2000, making up about a quarter of the city's population. The black population makes up 15% of the total, and the Hispanic population constitutes 5% of Frederick's 52,843 residents. In this chapter, I conduct many of the same analyses as in Washington and Alexandria. The analyses are also ordered in a similar fashion.

ZONING ORDINANCE AND MAP

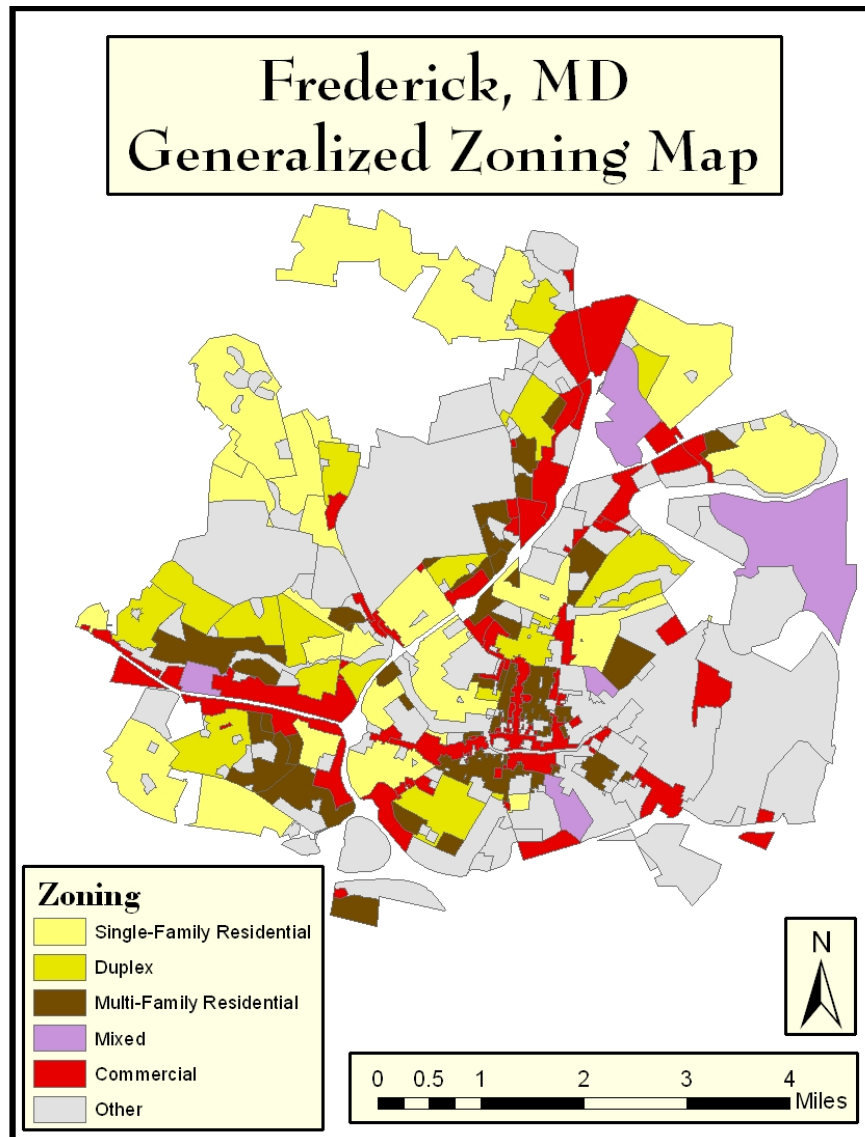
The zoning ordinance for Frederick, MD is less detailed than the Washington and Alexandria zoning ordinances. Table 6.1 shows the various districts in Frederick. The city has 7 residential districts, 3 commercial districts, 3 office districts, 3 industrial districts, one mixed-use district and 3 other districts. The residential zoning districts, can be interpreted as R-x, where x = the maximum permitted density in dwelling units per acre. Thus, the R-4 district permits up to 4 units per acre, while the R-20 district permits up to 20 units per acre. R-4 and R-6 are the lowest-density districts and allow only single-family detached uses. The cumulative nature of

TABLE 6.1 – Frederick, MD Zoning Districts

Density	Residential		Other			
	District	Description	District	Description	District	Description
Low ↓ High	R-4	Single-Family Detached	NC	Commercial	RC	Conservation
	R-6	Single-Family Detached	GC	Commercial	IND	Industrial
	R-8	Single-Family/ Duplex	DB	Commercial	M1	Industrial
	R-12	Multi-Family	DBO	Office	M2	Industrial
	R-16	Multi-Family	RO	Office	POS	Open Space
	R-20	Multi-Family	PB	Office	INT	Institutional
	DR	Multi-Family	MU	Mixed		

Data Source: City of Frederick

FIGURE 6.1



Data Source: City of Frederick

Frederick's ordinance means that the higher-density zoning districts also permit single-family dwelling units. In addition to single-family units, the R-8 district also permits duplexes, while R-12, R-16, R-20 and DR permit single-family and multi-family uses.

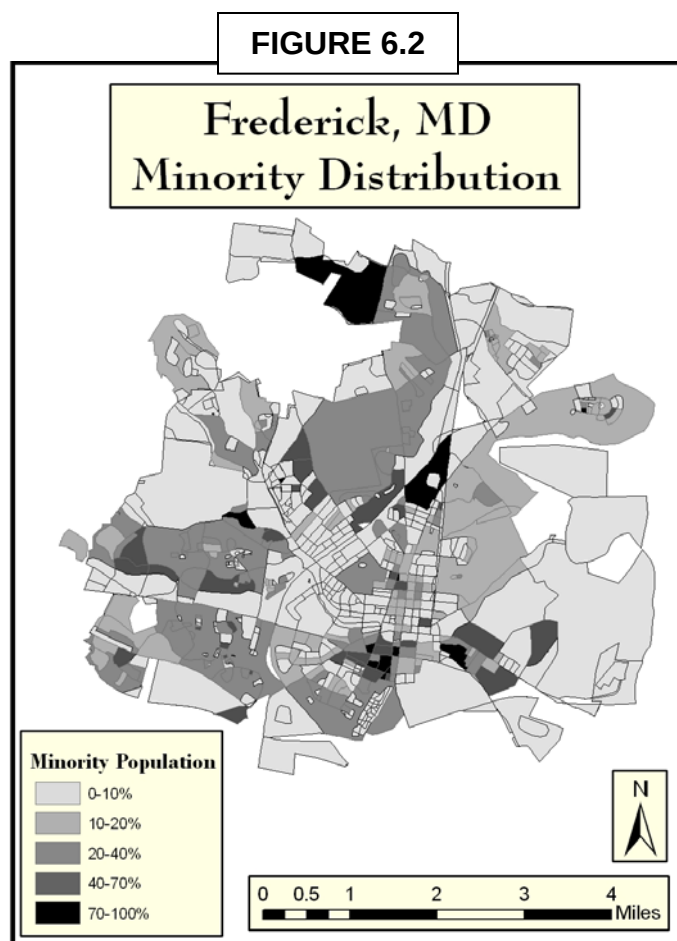
Frederick's zoning map is shown in Figure 6.1. Frederick's multi-family, single-family and duplex-zoned areas are more evenly distributed throughout the city than in Washington or Alexandria. There are, however, large, relatively isolated tracts of single-family zoned land along the city's northwestern boundary.

RACIAL/ ETHNIC DISTRIBUTION

Visual Analysis

Frederick's minority distribution map, Figure 6.2, shows a pattern in which the minority population has high concentrations in various parts of the city. When looking at just single-family districts (Figure 6.3), there are several Census blocks with high minority proportions spread across the city. In fact, there are few areas of single-family districts that are isolated from Census blocks with high minority proportions. The racial composition across multi-family districts, shown in Figure 6.4, illustrates that there are even more Census blocks with a high minority proportion within multi-family districts. Again, the distribution of Census blocks high in minority population is not relegated to one corner of the city. Rather, minority proportions are high in multi-family districts across numerous portions of the city.

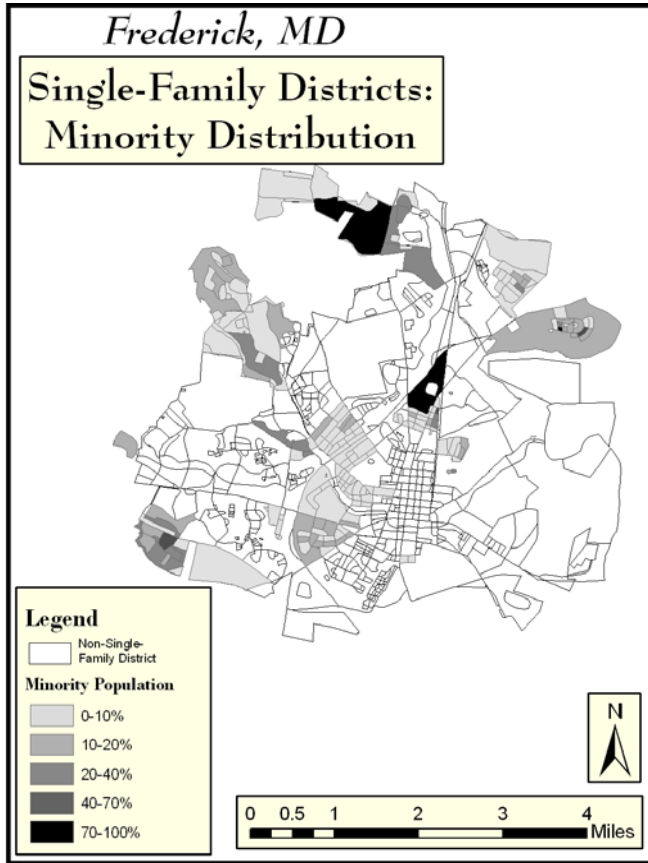
As expected based on the city's overall minority distribution, there are no large contiguous areas of minority clustering in Frederick. White clustering, shown in Figure 6.5, also



Data Source: US Census 2000; City of Frederick

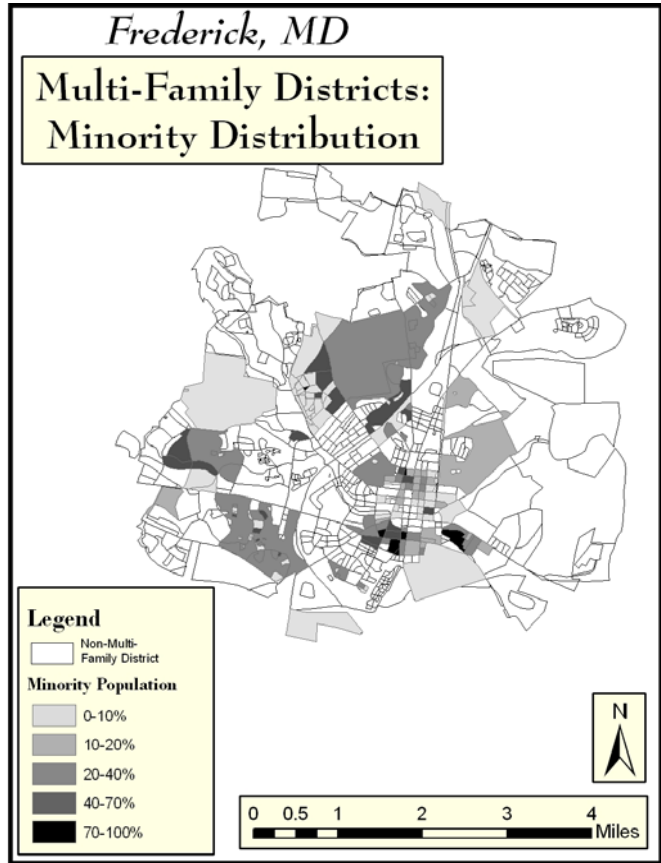
occurs in locations throughout the city rather, but the largest area is near the city's geographic center. This area is primarily zoned for single-family residential units. Figure 6.6 shows Frederick's minority clustering areas. Like white clustering, minority clusters are spread throughout the city. Most of the minority clustering, however, occurs outside of single-family districts.

FIGURE 6.3



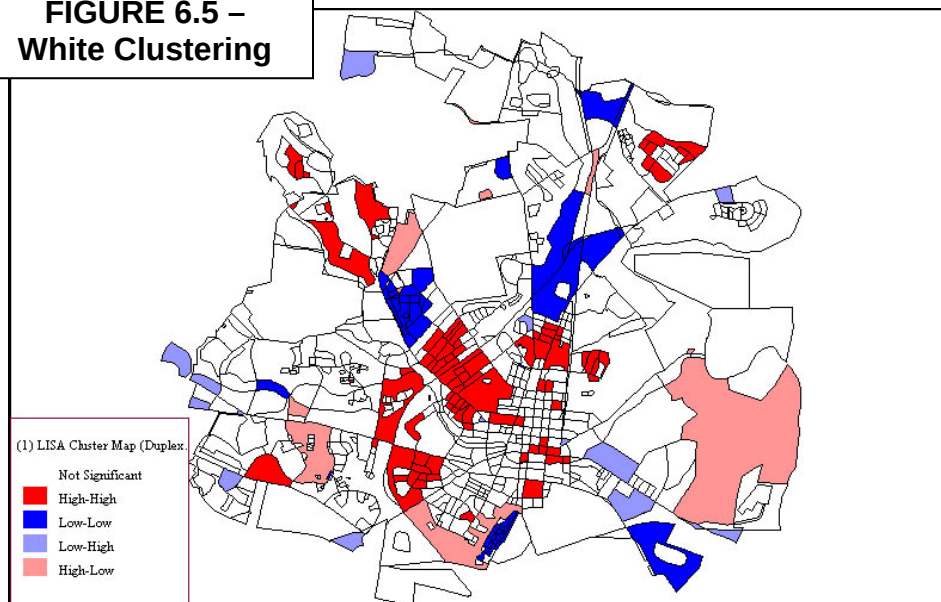
Data Source:US Census 2000; City of Frederick

FIGURE 6.4

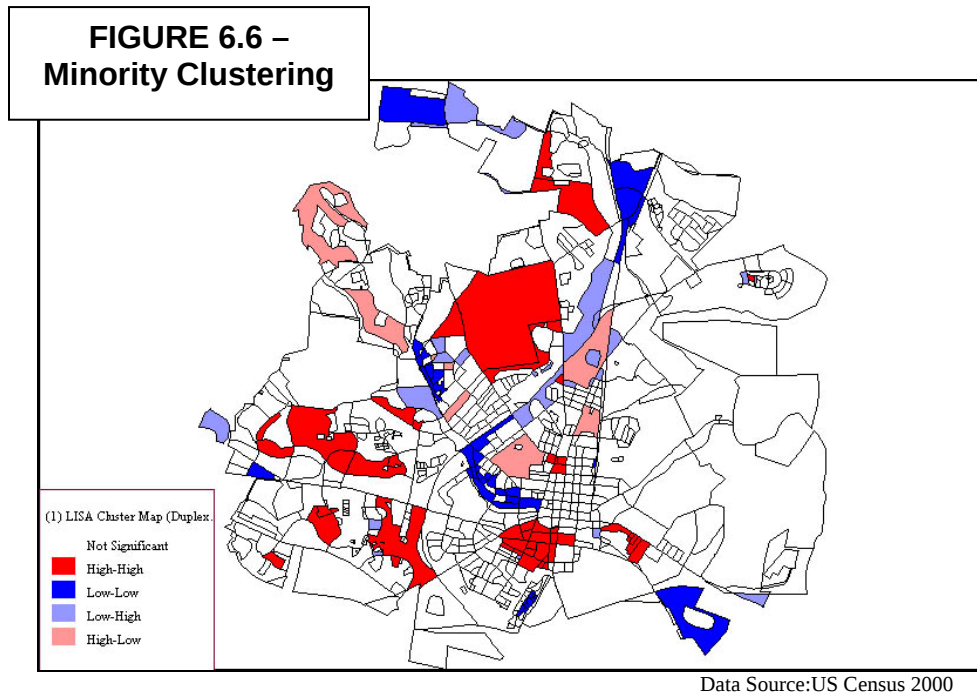


Data Source:US Census 2000; City of Frederick

**FIGURE 6.5 –
White Clustering**



Data Source:US Census 2000



Quantitative Analysis

As was the case in Washington, D.C. and Alexandria, Frederick's single-family districts contain much fewer minorities than its other more intensive residential zoning districts. Table 6.2 shows the racial composition of each zoning district, and Table 6.3 shows the city's racial composition by zoning type. Examination of Table 6.2 shows that minority populations are lowest in the R-4, R-6, R-20 and MU districts. The R-20 and MU districts have the lowest total populations of any of Frederick's zoning districts, explaining the low minority populations in these high-density districts. The R-4 and R-6 districts' low minority population is consistent with expectations that minority populations will be smaller in low-density zoning districts. The highest Hispanic population is located within the R-16 district, while the highest black population is located in the R-8 district. More Hispanics than blacks in Frederick are relying on the higher densities permitted in the R-16 district.

TABLE 6.2 – Racial Composition by District

Zoning	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population
R-4	117	2,734	6,290	316	154	5,629	751
R-6	117	882	6,316	341	119	5,701	698
R-8	173	2,132	14,855	1,775	598	11,987	3,149
R-12	42	1,065	8,688	1,569	429	6,309	2,550
R-16	39	494	6,858	1,393	801	4,294	2,826
R-20	3	52	808	121	62	560	273
DR	68	724	6,366	1,763	207	4,298	2,167
MU	51	1,683	1,418	390	154	847	642
Totals	742	13,166	52,843	7,777	2,533	40,729	13,199

Data Source: U.S. Census 2000; City of Frederick

TABLE 6.3 – Racial Composition by Zoning Type

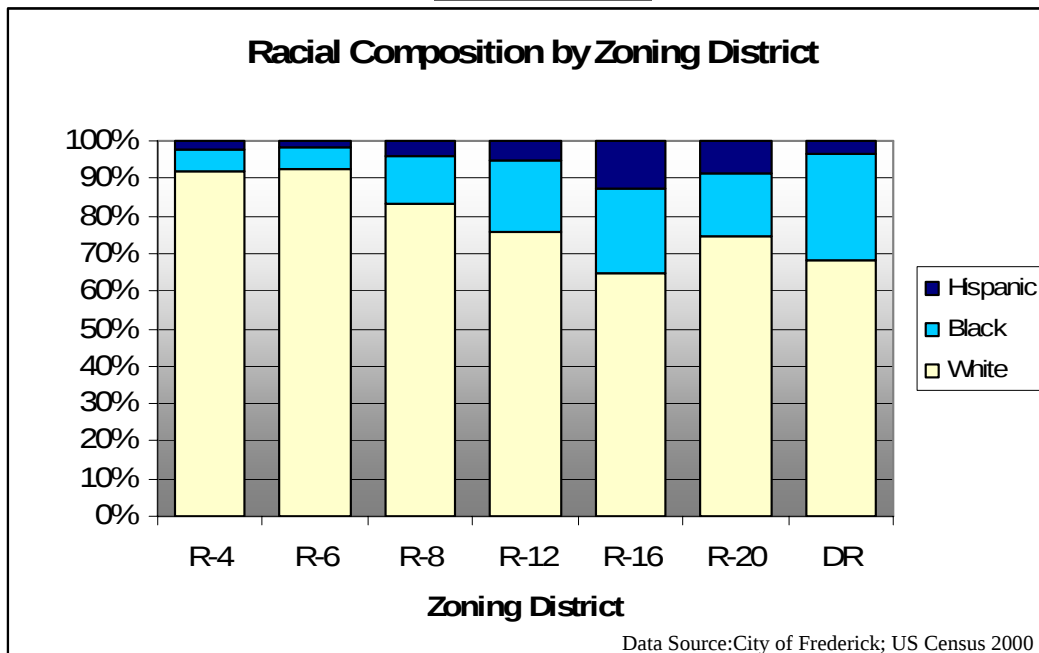
Zoning	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population
Single-Family	234	3,615	12,606	657	273	11,330	1,449
Duplex	173	2,132	14,855	1,775	598	11,987	3,149
Multi-Family	203	4,018	24,138	5,236	1,653	16,308	8,458
Residential							
Totals	610	9,765	51,599	7,668	2,524	39,625	13,056

Data Source: U.S. Census 2000; City of Frederick

Minority, black and Hispanic populations increase as more housing types are permitted. All three population groups more than double in size from single-family to duplex districts and nearly triple in size from duplex districts to multi-family districts. White population increases as more housing types are permitted, but this population increase is much less significant – less than a 50% increase from single-family districts to multi-family districts.

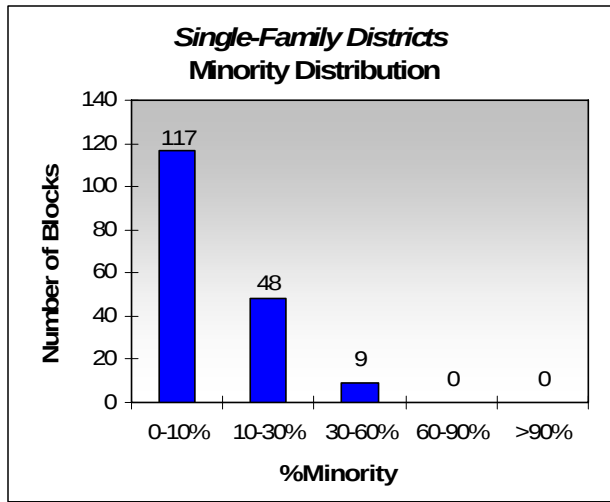
Chart 6.1 shows white, black and Hispanic population proportions in each zoning district. The chart shows a fairly consistent trend that as zoning-district density increases black and Hispanic proportions also increase. The R-20 district has a slightly higher than expected white proportion, but only 3 Census blocks were defined to be within the R-20 district. The overall low population in this district reduces the significance of the high white proportion in this district. If the R-20 proportions are discarded, Frederick's minority proportions exhibit higher correlations with zoning district type and density than seen in both Alexandria and Washington.

CHART 6.1

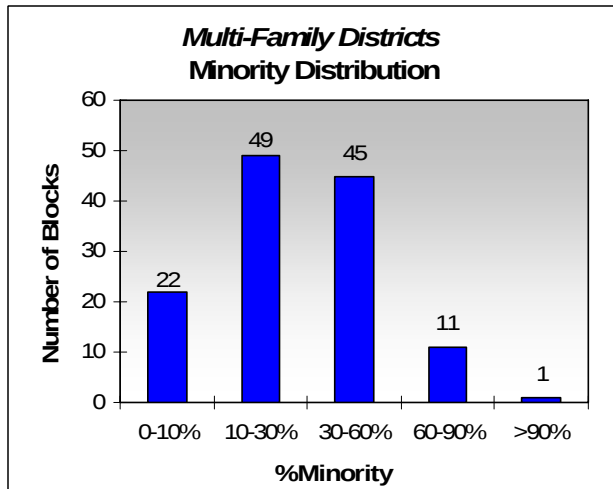


Segregation Trends

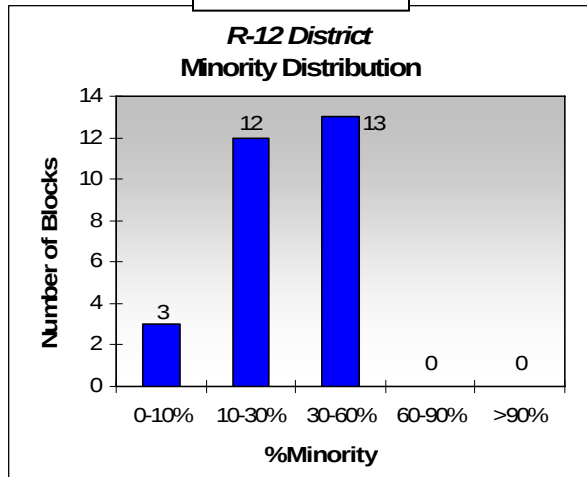
This data shows that racial compositions vary from zoning district to zoning district, but it tells us nothing about the way that the population is distributed within these zoning districts. Charts 6.2 and 6.3 show histograms of minority proportion classes in single-family zoning districts and multi-family districts. Minorities are fairly well-integrated within each zoning type. The single-family districts have more areas devoted to a mainly white population, but most Census blocks within multi-family districts have a moderate amount of minorities (10-60%).

CHART 6.2

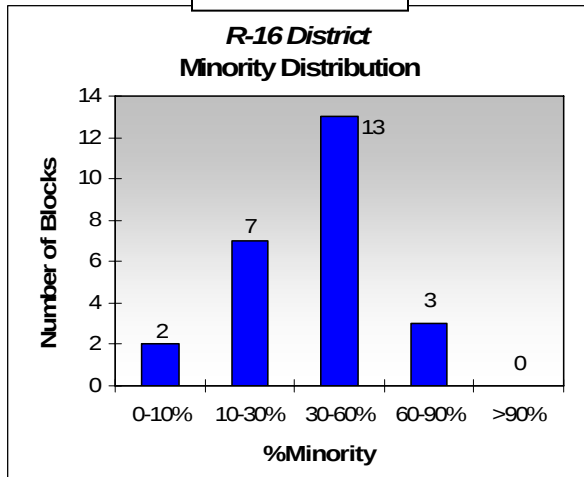
Data Source: City of Frederick; US Census 2000

CHART 6.3

Data Source: City of Frederick; US Census 2000

CHART 6.4

Data Source: City of Frederick; US Census 2000

CHART 6.5

Data Source: City of Frederick; US Census 2000

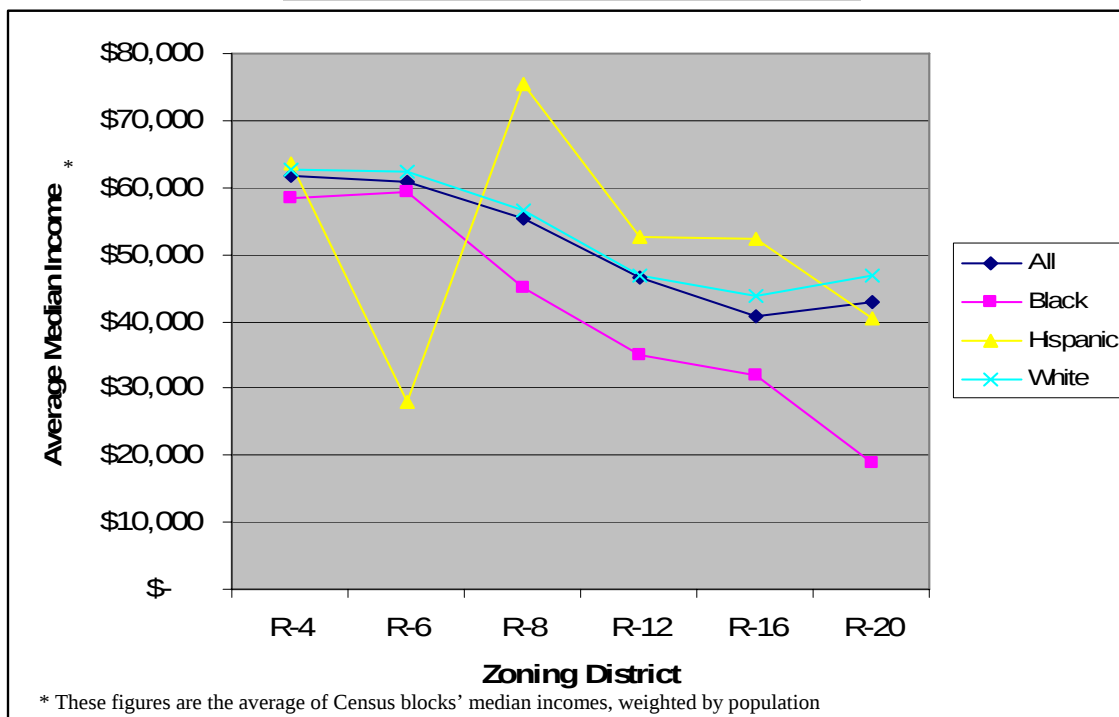
Zoning density is also consistent with minority population distributions. Charts 6.4 and 6.5 show that minorities within the R-12 district, the lowest-density multi-family district, are better integrated than minorities within the higher-density, R-16 district. In the R-12 districts, no Census blocks have minority populations greater than 60% of the block's total. The minority population mainly resides in Census blocks that are at least one-half white. In the R-16 district, most Census blocks contain a minority population making up at least 30% of the block's total. 3 Census blocks (about 12% of the blocks within the R-16 districts) have minority populations exceeding 60% of the total population. Although this is not comparable to the lack of integration

occurring in Washington, the higher-density district's minority population is less integrated than the lower-density multi-family district.

Income Distribution

Frederick's income distribution is more consistent with its racial and ethnic population distributions than was the case in Alexandria and Washington. Washington's income distribution was more consistent with zoning density than its minority population distribution. Alexandria's income distribution was less closely correlated to zoning density than its minority population distribution. In Frederick, both income distribution and minority population distribution are consistent with zoning density. Chart 6.6 shows that as zoning density increases, median incomes decrease for whites, blacks and the total population. Hispanics are the exception to this trend as this group exhibits variability in incomes not corresponding to zoning density.

CHART 6.6 – Income Distribution



Data Source: City of Frederick; US Census 2000

TABLE 6.4 – Housing Density

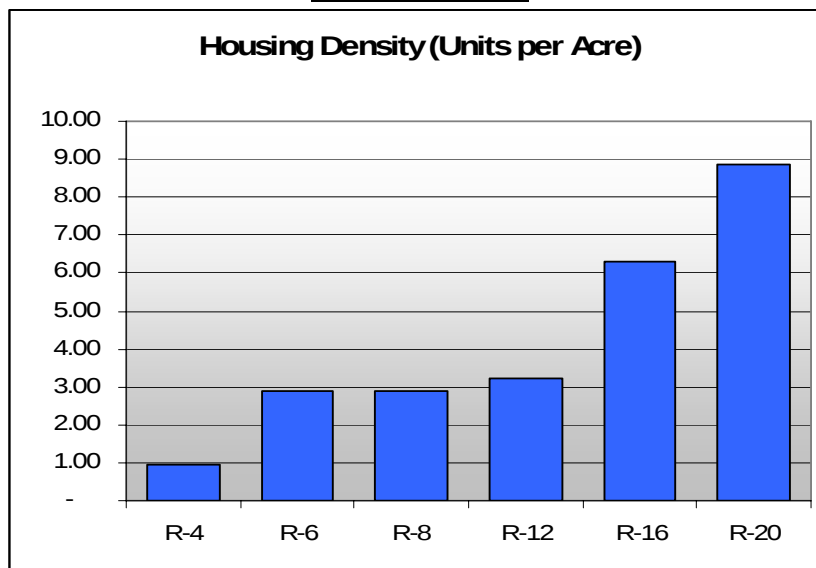
Zoning	Area (Acres)	Housing Units	Housing Density (Units per Acre)
R-4	2,734	2,608	0.95
R-6	882	2,530	2.87
R-8	2,132	6,148	2.88
R-12	1,065	3,426	3.22
R-16	494	3,127	6.33
R-20	52	458	8.86
DR	724	3,093	4.27
Single-Family	3,615	5,138	1.42
Duplex	2,132	6,148	2.88
Multi-Family	1,611	7,011	4.35
All Zones	7,358	18,297	2.49

Data Source: U.S. Census 2000; City of Frederick

HOUSING STOCK ANALYSIS

Frederick's housing stock accurately reflects the zoning regulations of each zoning district. Table 6.4 and Chart 6.7 show that as zoning density increases, housing density also increases. Density sharply increases from the R-4 to the R-6 district, then increases sharply again from the R-12 to the R-16 and also to the R-20 district. Housing density in

multi-family districts is more than three times the housing density found in single-family districts. The multi-family districts also offer more total housing units than single-family or

CHART 6.7

Data Source: City of Frederick; US Census 2000

duplex zoning districts.

Although housing density increases with zoning density, the increase is not linear. From the R-6 district to the R-12 district, housing density only increases minimally despite the fact that zoning districts permit an additional 6 units per acre across this span. As a result, housing densities are higher

than expected in the R-6 district but lower than expected in the R-12 district. The higher than expected housing density is not reflected by minority composition within the R-12 district – this district actually has a slightly higher proportion of minorities than the R-20 district.

Like Washington, Frederick's zoning ordinance is cumulative. Thus, multi-family districts also permit single-family housing units. To verify the finding that Frederick's minority

population correlates more with availability of housing type than with housing density, the housing stock of each zoning district needs to be analyzed for housing types. Table 6.5 shows home-ownership rates. Again, we have to assume that ownership rates will be highest where single-family housing units are dominant and lowest where multi-family units dominate. The table shows that for all groups and the population as a whole, ownership rates dramatically decline from single-family zones to duplex zones and from duplex zones to multi-family zones.

TABLE 6.5 – Housing Tenure and Vacancy

Zoning	Housing Units	Vacancy Rates	Ownership Rates				
			All	Black	Hispanic	White	Minority
R-4	2,608	5%	90%	90%	93%	90%	90%
R-6	2,530	3%	84%	59%	84%	86%	72%
R-8	6,148	5%	69%	55%	50%	72%	56%
R-12	3,426	3%	56%	41%	47%	60%	44%
R-16	3,127	8%	26%	18%	7%	32%	15%
R-20	458	9%	21%	34%	5%	22%	18%
DR	3,093	9%	37%	22%	30%	43%	23%
Single-Family	5,138	4%	87%	75%	89%	88%	82%
Duplex	6,148	5%	69%	55%	50%	72%	56%
Multi-Family	7,011	6%	39%	27%	20%	46%	26%
All Zones	18,297	7%	59%	37%	35%	66%	39%

Data Source: U.S. Census 2000; City of Frederick

Frederick's ownership rate of 39% in multi-family districts, however, is significantly higher than multi-family homeownership rates in Washington and Alexandria (21% and 22%, respectively). Thus, while Frederick's multi-family districts most likely contain abundant multi-family housing units, there are most likely higher amounts of townhouses and/or single-family housing units within multi-family districts than in multi-family districts in Alexandria and Washington. Although Frederick's ownership rates do not prove that all or even most housing units within multi-family districts are multi-family units, the rates confirm that there is a difference in housing type consistent with the most intensive residential use permitted by each zoning type.

SUMMARY

Frederick's racial and ethnic compositions dramatically vary across zoning districts. Frederick has a minority population that closely correlates with zoning density and zoning type.

Zoning is also connected to levels of minority integration across the city. Low-density, multi-family zones have a highly-isolated white population. Within multi-family districts, the minority population is fairly integrated, but this level of integration declines as zoning density increases. The least-integrated minority population is found in the highest-density multi-family zones.

This strong correlation that the minority population distribution has with zoning districts could be due to Frederick's high recent population growth. From 1990 to 2000, Frederick's population grew by about 30%. During the same time, D.C.'s population declined, and Alexandria's population grew by about 15%. Frederick's minority population nearly doubled (from under 7,000 to over 13,000) during this 10-year time frame. This high population growth, particularly the minority growth, most likely is enabling zoning to have a greater effect on new housing. Considering that nearly half of the minority population in Frederick settled there in the last ten years, historical minority settlement patterns play a lesser role in Frederick. Also, laws against housing discrimination such as the 1968 Fair Housing Act reduce the effect that racial prejudice plays in determining racial settlement. These could be contributing factors in influencing higher consistencies among minority populations and zoning.

CHAPTER 7: MONTGOMERY AND PRINCE GEORGE'S COUNTY

Montgomery and Prince George's County are both located adjacent to Washington on the Maryland side of the city, but these Counties have quite different demographics. Montgomery County is an important part of the Washington, D.C. MSA with a population of 873,341 in 2000. Since 1990, its population has grown by over 100,000. During this period, the county has become much more diverse. In 1990, Montgomery County's population was only made up of 28% minorities (12% black and 7% Hispanic). By 2000, over 40% of the County's population belonged to a minority (15% black and 12% Hispanic). Montgomery County's inclusionary zoning ordinance, established in 1974, requires all new developments of 35 units or greater to make at least 10 to 15 percent of new residential units affordable to people making less than the MSA's median income (Brunick, 2006; Nelson, 2006). Considering that Montgomery County is the nation's sixth wealthiest county, this inclusionary zoning ordinance has been an influencing factor in enabling higher amounts of low-income minorities to settle in the county. In fact, the county has established over 10,000 new affordable housing units since 1974 (Wikipedia, 2007).

Prince George's County had a 2000 population of 801,327, with over 76% of this population belonging to a minority. Over 500,000 blacks reside in Prince George's County, making up a majority of the population. This chapter consists of the same analyses of racial distribution and racial segregation within and across zoning districts as seen in previous chapters.

ZONING CLASSES AND ZONING MAPS

I was unable to obtain zoning shapefiles directly from Montgomery County and Prince George's County. Rather, I acquired zoning information for these counties from the Maryland Department of Planning. The Maryland Department of Planning provides generalized zoning data for each County in Maryland. Rather than showing each zoning district, the Maryland Department of Planning aggregates zoning districts into the following residential classes (Maryland Department of Planning (2)):

Very low density residential – Maximum residential density less than 1 dwelling unit per acre.

Low density residential – Maximum residential density greater than or equal to 1 unit per acre and less than 3.5 dwelling units per acre.

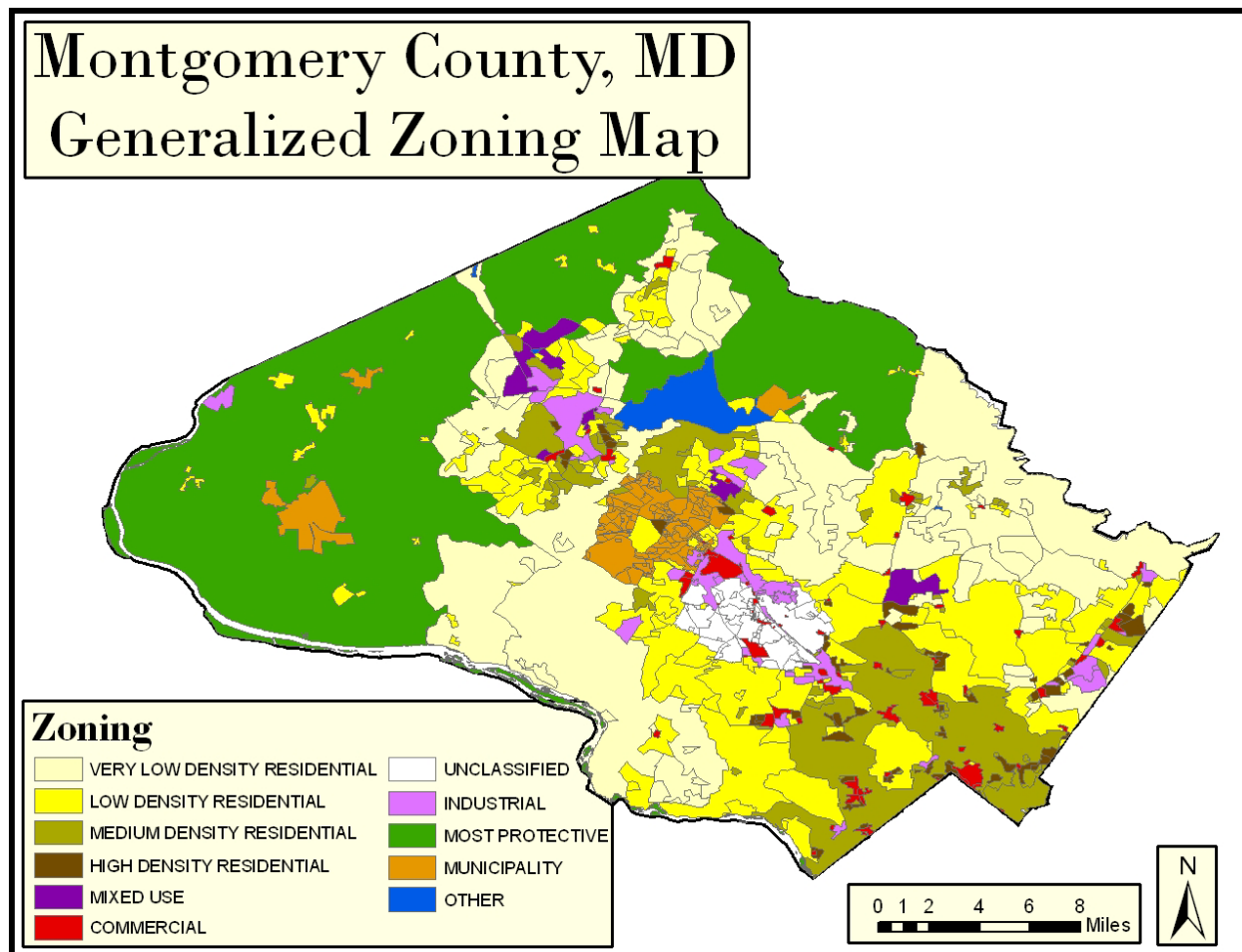
Medium density residential – Maximum residential density greater than or equal to 3.5 dwelling units per acre and less than 10 dwelling units per acre.

High density residential – Maximum residential density greater than or equal to 10 dwelling units per acre.

Most/ Least protective – Districts that intend to protect natural resources and conserve open spaces.

Having generalized zoning shapefiles greatly facilitates my study because the generalized zoning districts typically cover much more space than actual zoning districts. This makes aligning zoning districts with Census blocks easier, but it also results in the loss of detail. Rather than having the racial and ethnic composition of each zoning district, I can only calculate population figures across entire zoning types.

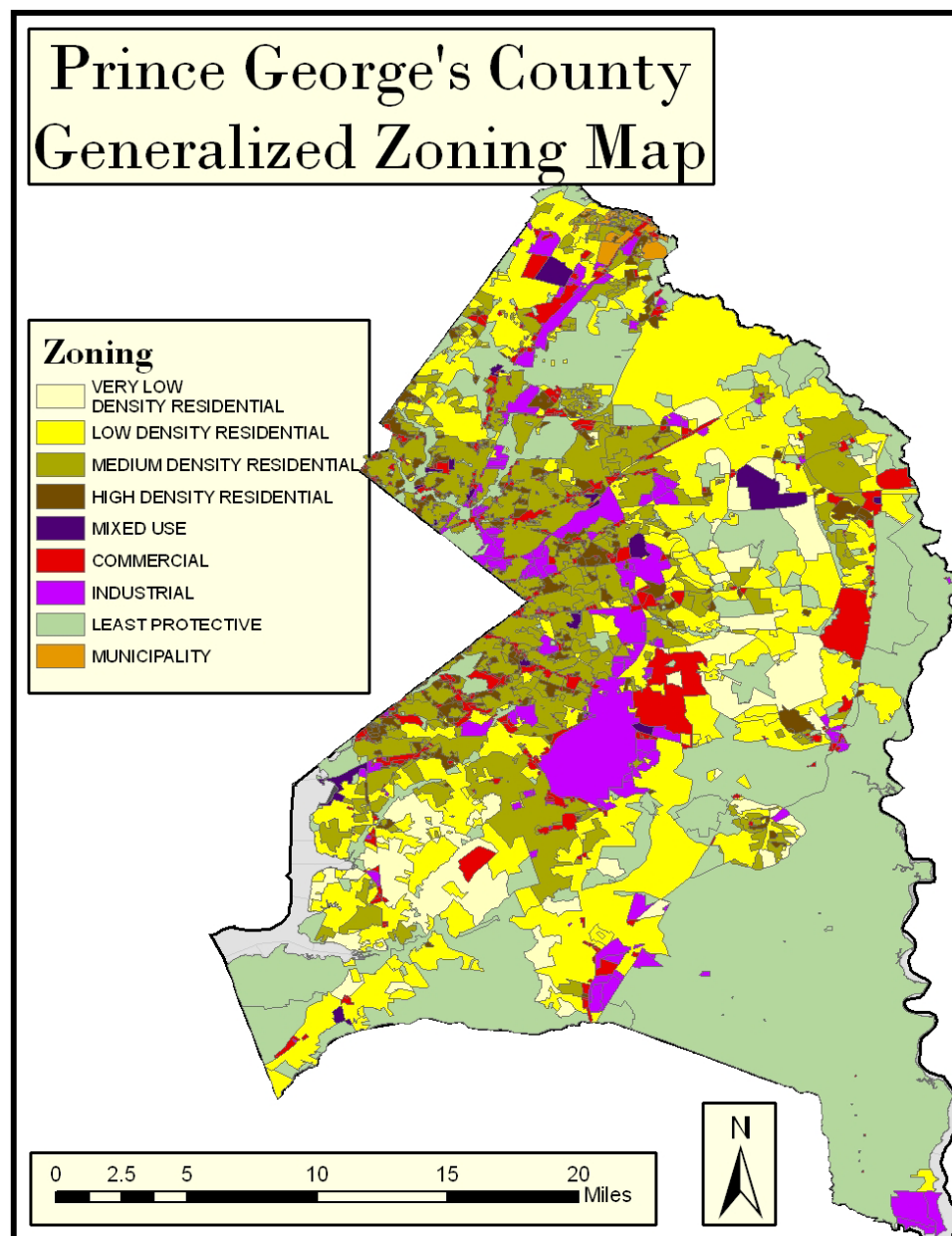
FIGURE 7.1



Data Source: Maryland Department of Planning

Montgomery County's zoning map (Figure 7.1) shows what one would expect of a suburban county – medium and high density zoning near Washington, D.C. (Southeastern Montgomery County), with residential density gradually declining upon moving away from D.C. The fringes of Montgomery County are dominated by protective zoning not designed for significant residential development. Overall, Montgomery County contains very little high-density residential zoning, with considerably more land devoted to low and very-low-density zoning.

FIGURE 7.2



Data Source: Maryland Department of Planning

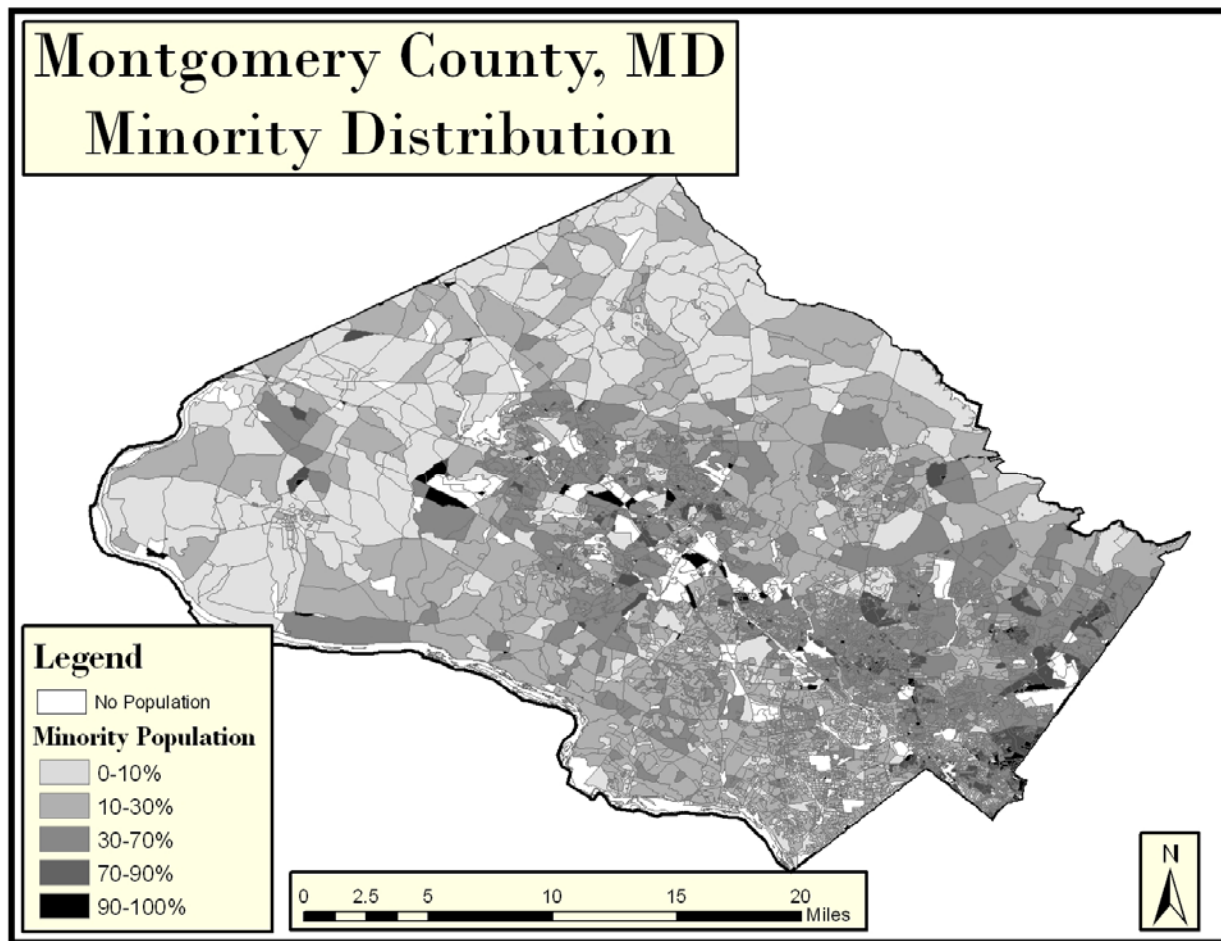
Prince George's County also has large amounts of high-density and medium-density residential zoning near Washington, D.C. (the City's central western edge). Prince George's County contains considerably less land devoted to very-low-density residential zoning. Rather, the county is dominated by a mixture of residential zoning types with protective land in the county's fringes.

RACIAL/ ETHNIC DISTRIBUTION

Visual Analysis

The racial distribution of these two counties does not perfectly reflect these zoning maps, but there is a high degree of correlation shown. Montgomery County, shown in Figure 7.3, has few Census blocks that contain a minority population that exceeds 70%. These high-minority Census blocks are fairly well distributed throughout the county, but few of these Census blocks are located within low-density zoning districts and even fewer are located in very low density districts. The Census blocks high in minority population that are located near Washington (Southeastern Montgomery County) are mostly located in medium and high-density zoning districts (although some fall within low density or unclassified zoning districts near an industrial zoning district). The high minority population in Census blocks in the center of the county is clustered around a municipality and consists mostly of medium density and municipal zoning districts. A few of these blocks are also located within low-density zoning districts. High white populations dominate most of the outer edges of the county. These areas mostly consist of protective and very low density zoning.

FIGURE 7.3

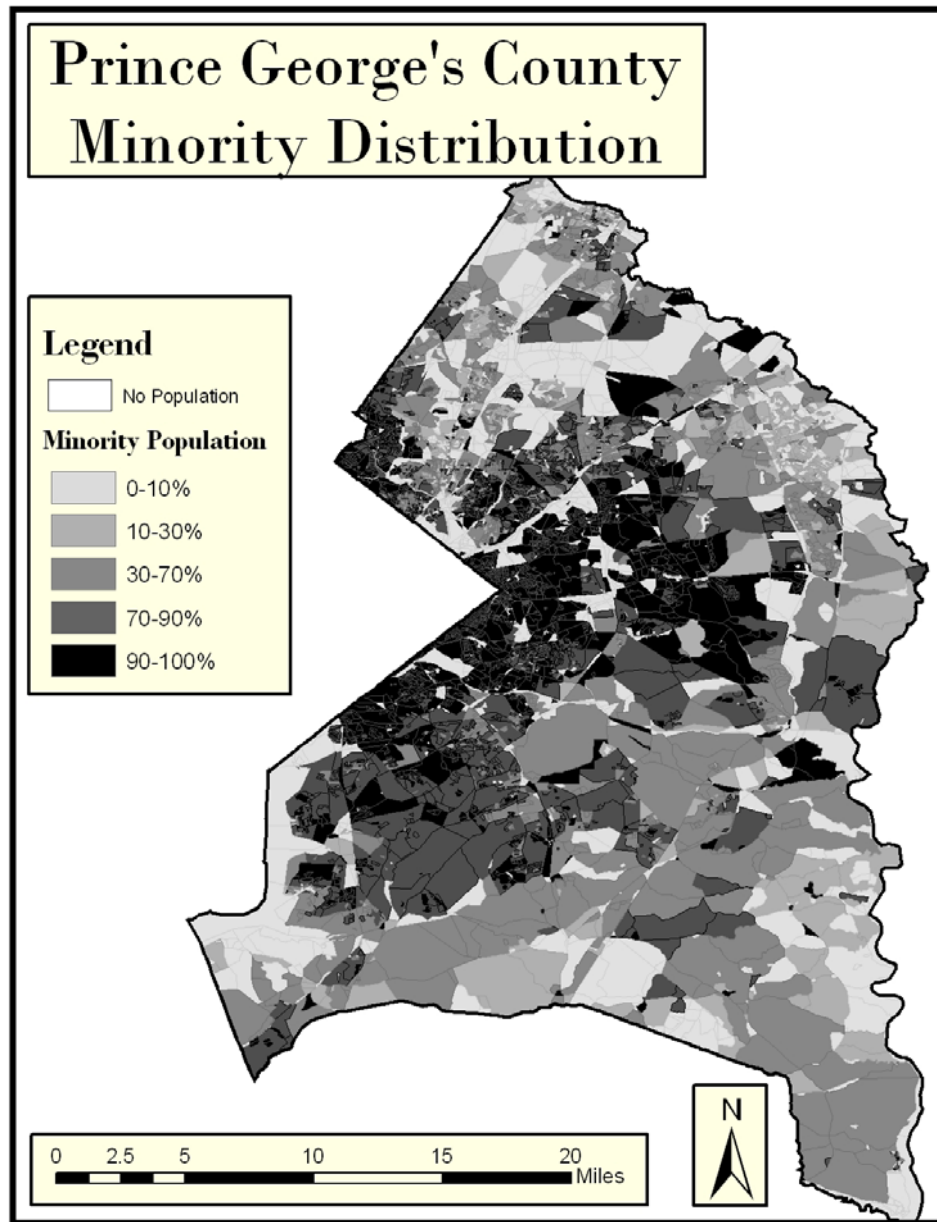


Data Source: US Census 2000

Prince George's County, on the other hand, has a much higher number of Census blocks with a minority population making up more than 70% of the block's total population. Figure 7.4 shows that minority population is particularly high in the western portion of the city near Washington, D.C. This high minority population is adjacent to the high minority population occupying the majority of the eastern half of D.C. These areas of high minority population largely consist of medium and high-density zoning districts (districts that permit more than 3.5 units per acre). Some of these Census blocks with a high proportion of minorities expand a good distance east of the central city and occupy some areas zoned for low-density residential. As was the case in Montgomery County, the outer edges of the County have higher white populations than elsewhere in the county. These areas consist mainly of protective and low or very-low-

density zoning. These maps of the two counties' racial distribution indicate that minority populations are somewhat correlated with zoning density.

FIGURE 7.4



Data Source: US Census 2000

Clustering within Montgomery County occurs in large amounts in a few different areas of the county. White clustering (shown by red polygons in Figure 7.5) occurs to a large extent in the northern and western edges – the locations furthest from the central city. Minority clustering, shown in Figure 7.6, is more common in the eastern and central portions of the county.

FIGURE 7.5 – White Clustering

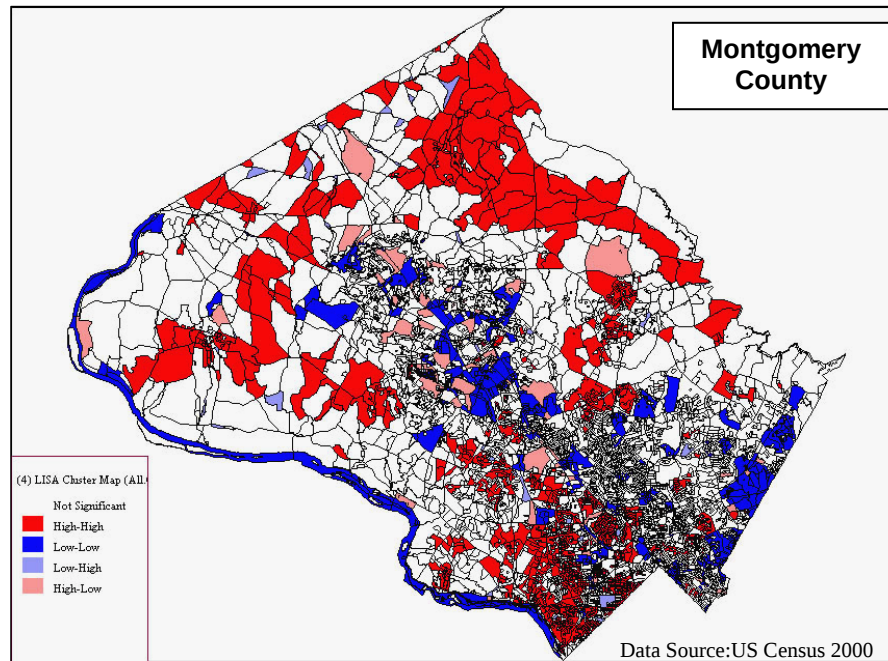
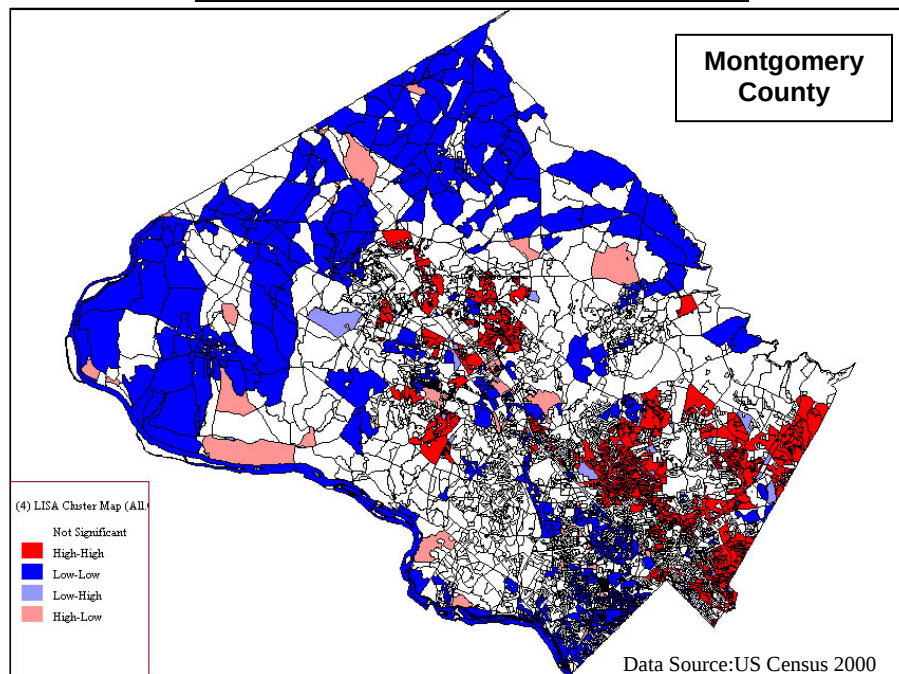
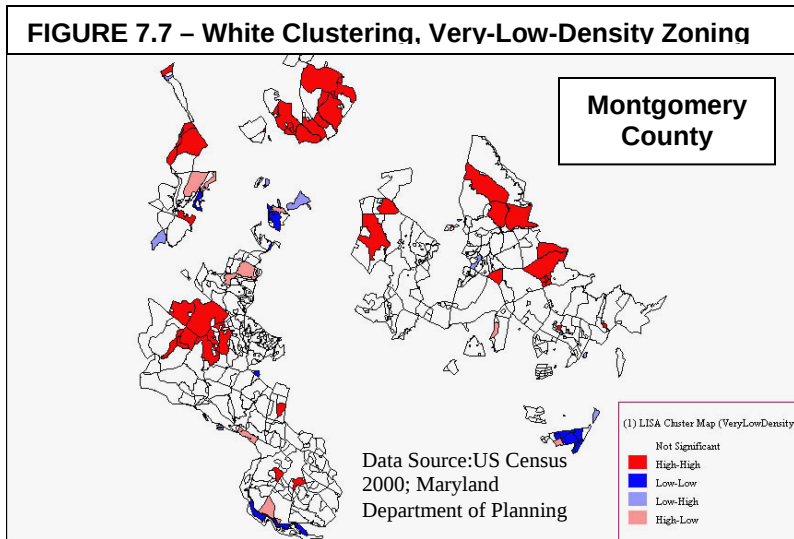


FIGURE 7.6 – Minority Clustering



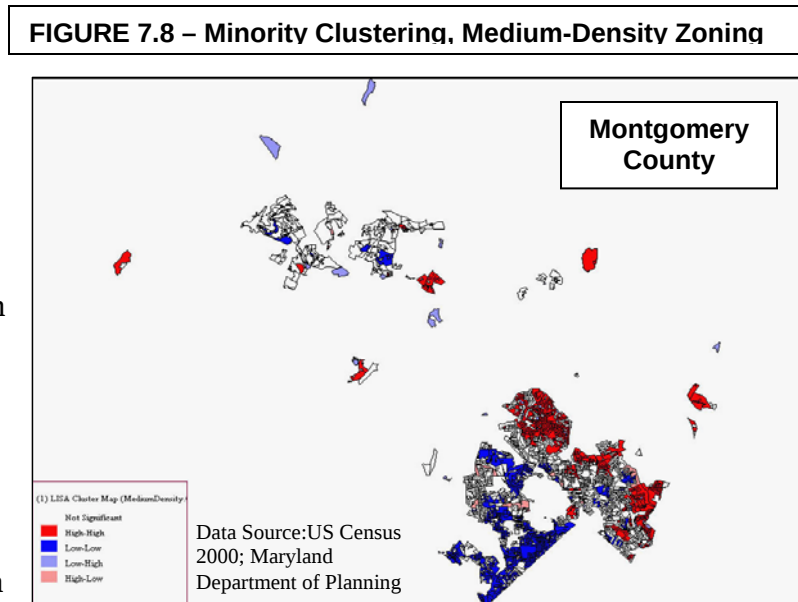
Much of the white clustering in the county occurs within very-low-density or protective



zoning districts. Figure 7.7 shows the high incidence of white clustering within very-low-density zoning districts. Significant amounts of minority clustering occur within medium-density zoning districts as shown in Figure 7.8. Surprisingly, however, there is a large amount of minority clustering occurring

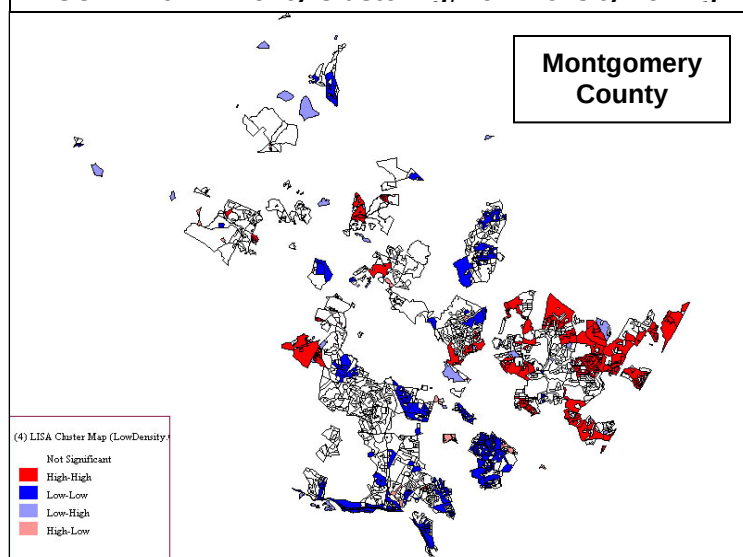
within low-density zoning districts (Figure 7.9). These clustering patterns show some consistency with zoning density, but also show some conflict with zoning density. If zoning completely determined minority settlement, minority clustering would be constricted to the medium and high-density zoning districts. Instead, minorities cluster to an extent in low-density zoning districts, and whites cluster in certain areas within medium-density zoning districts.

Prince George's County's clustering patterns are highly consistent with the racial distribution



patterns shown in Figure 7.4. White clustering is common in the outer edges of the county (Figure 7.10). There are few Census blocks high in white population near Washington, D.C., and there are even fewer Census blocks that are also near blocks high in white population. This white clustering occurs mostly in protective, low or very-low-density zoning districts.

FIGURE 7.9 – Minority Clustering, Low-Density Zoning



Data Source: US Census 2000;
Maryland Department of Planning

FIGURE 7.10 – White Clustering

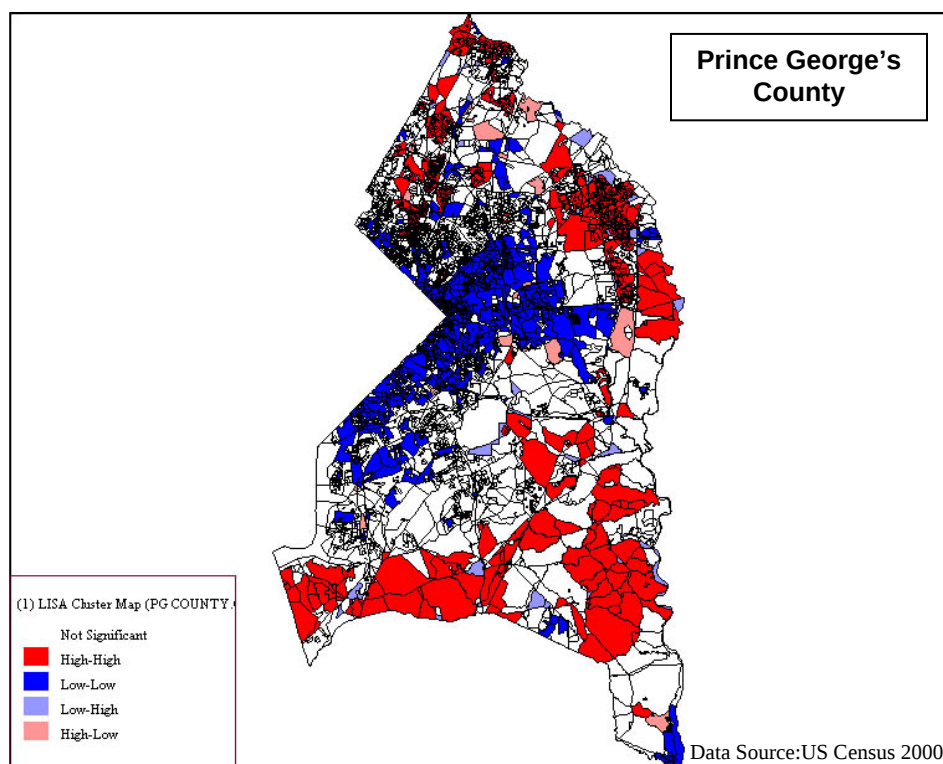


FIGURE 7.11 – Minority Clustering

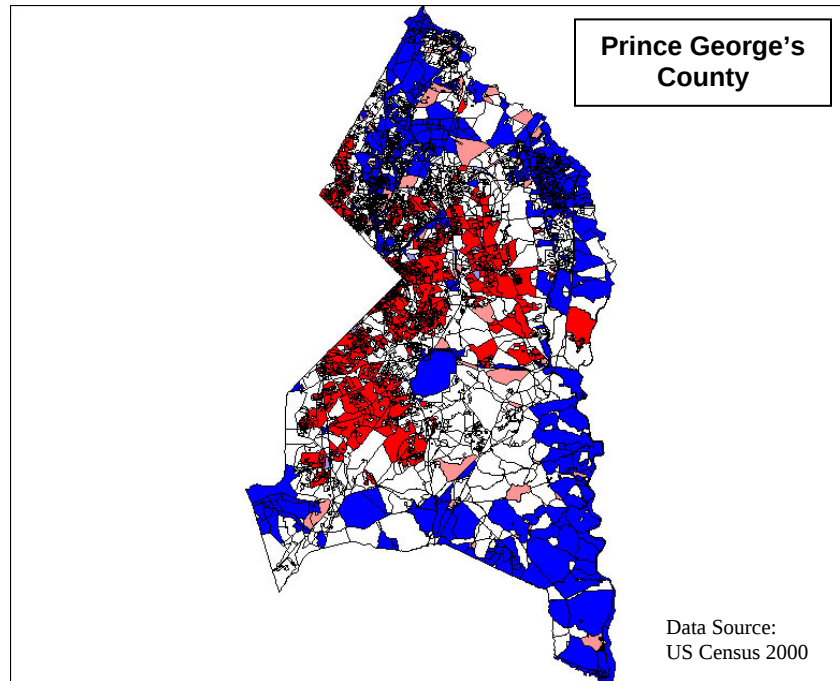
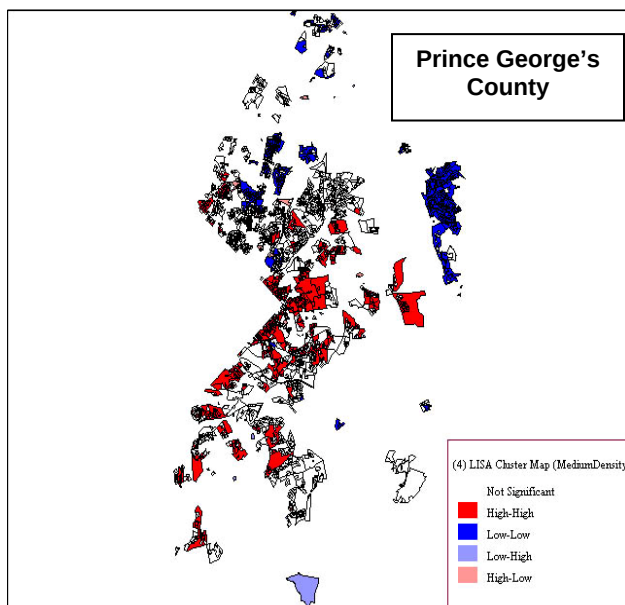


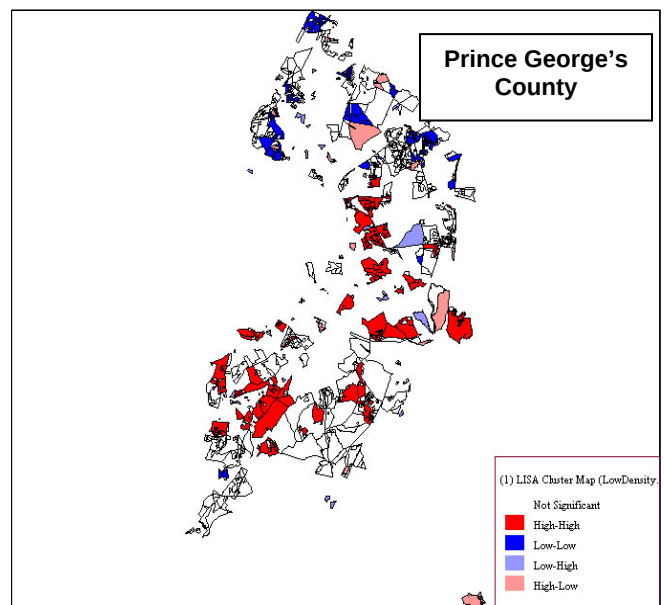
Figure 7.11 shows that minority clustering occurs much nearer to the central city. Large portions of the county experience minority clustering. These clustered areas cover a wide variety of zoning densities. Minority clustering occurs to great extents in low, medium and high-density zoning districts. Figure 7.12 shows minority clustering in medium-density zoning districts,

FIGURE 7.12 – Minority Clustering, Medium-Density Zoning



Data Source:US Census 2000; Maryland Department of Planning

FIGURE 7.13 – Minority Clustering, Low-Density Zoning



Data Source:US Census 2000; Maryland Department of Planning

while Figure 7.13 shows minority clustering in low-density zoning districts. Although clustering is more frequent in medium-density districts, low-density zoning is not preventing minority clustering within Prince George's County.

Quantitative Analysis

Statistical analysis of each county reveals the same trends as illustrated by racial distribution and cluster maps – the minority population is greater in higher-density zoning districts. Montgomery County's racial composition by zoning density is shown in Table 7.1 and Chart 7.1. Table 7.1 shows that the highest absolute number of minorities reside within zoning districts classified as having a medium density. Of the four residential districts, the fewest number of minorities reside within very-low-density zoning districts. Whites are also low in population in very-low-density zoning districts. Minorities actually constitute more than 20% of the population in very-low-density districts, but blacks and Hispanics comprise less than one-half of the minority population in these districts. Throughout the entire county, however, blacks and Hispanics make up well over two-thirds of the minority population. Non-black and non-Hispanic minorities, such as Asians, are more frequently locating in very-low density zoning districts than the black and Hispanic populations.

TABLE 7.1 – Racial/ Ethnic Composition – Montgomery County

Generalized Zoning (Res. Districts Only)	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population
Very Low Density	721	85,102	90,026	7,392	4,213	67,711	24,773
Low Density	2,197	56,533	237,077	28,675	16,900	163,590	82,308
Medium Density	2,939	30,865	281,508	43,835	40,551	181,237	117,886
High Density	279	4,753	90,852	28,236	16,936	39,615	58,002
Entire County	8,212	324,548	873,341	132,256	100,604	565,719	354,023

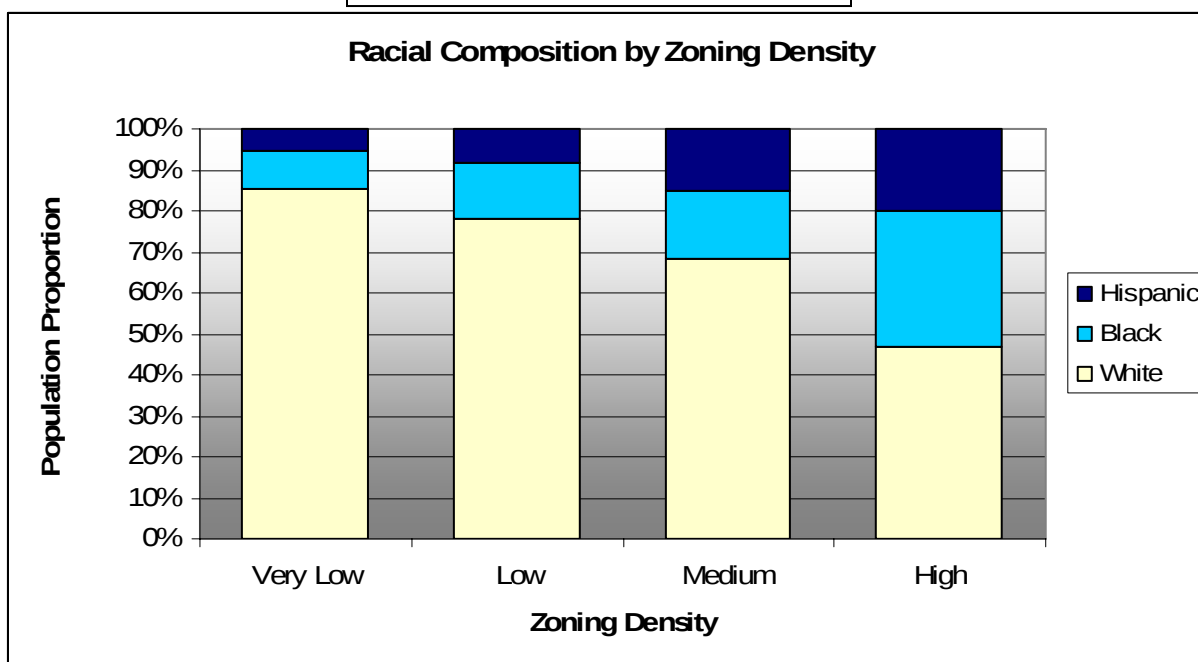
Data Source: U.S. Census 2000, Maryland Department of Planning

The highest white populations are found in low and medium-density zoning districts. Whites outnumber minorities in all four zoning density classes except the high-density zoning districts. Minorities outnumber whites by nearly 20,000 people in high-density zoning districts.

This is a stark contrast from the very low and low-density district in which whites outnumber minorities by approximately 40,000 and 80,000 people, respectively.

Chart 7.1 shows the obvious trend that minority proportions increase with zoning density. Hispanic and black population increase across each zoning class. Combined, blacks and Hispanics make up less than 20% of the population in very-low density zoning districts, but comprise over 50% of the population in high-density zoning districts. Although many minorities are able to locate in low and very-low-density districts, many more reside in medium and high-

CHART 7.1 – Montgomery County



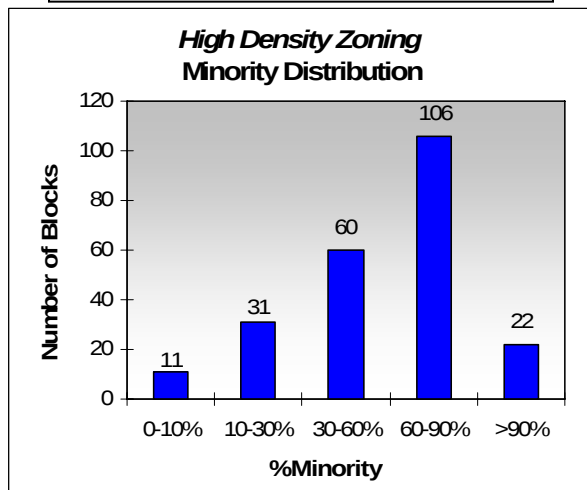
Data Source: US Census 2000; Maryland Department of Planning

density districts. Zoning density is more consistent with black and Hispanic populations than other minorities because other minorities are more common in the lower-density zoning classes.

This distribution of the minority populations within zoning-density classes is well-illustrated by two histograms showing the number of Census blocks that fall into different classes of minority proportion within high-density residential zones and very-low-density residential zones (Charts 7.2 and 7.3). Although high-density zones (Chart 7.2) have a minority population that comprises around 60% of the total, most Census blocks have a minority population higher than 60%. The minority population is not evenly distributed within these zoning district, but rather some segregation occurs. There are relatively few blocks that have a moderate minority

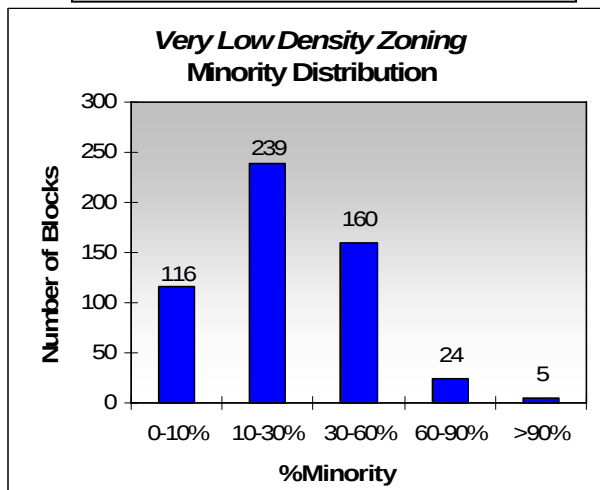
proportion, but there are some blocks with low minority populations (less than 30%) and many more blocks with a high minority population (greater than 60%).

CHART 7.2 – Montgomery County



Data Source: US Census 2000; Maryland Department of Planning

CHART 7.3 – Montgomery County



Data Source: US Census 2000; Maryland Department of Planning

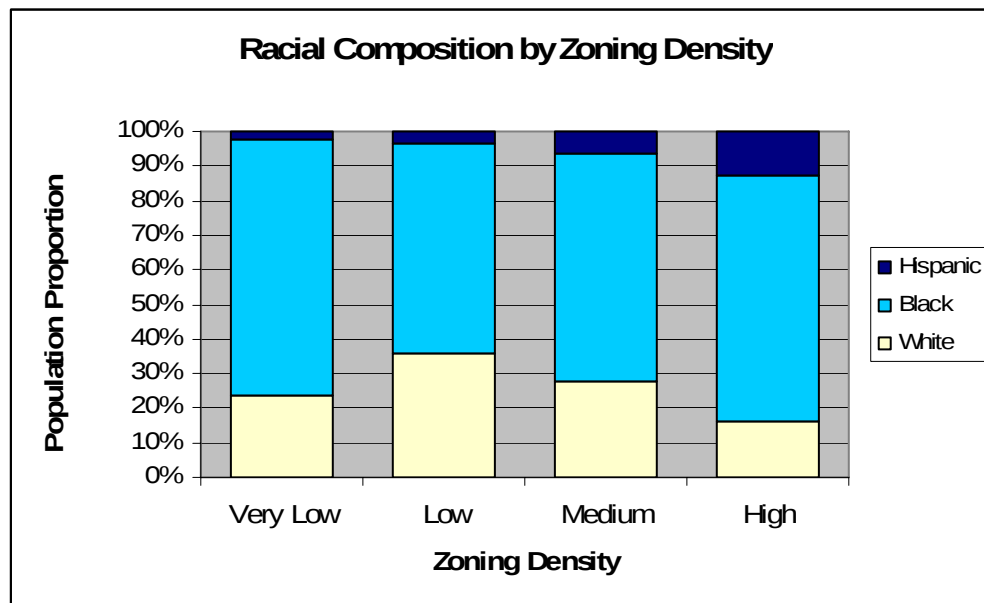
Very-low-density zoning districts (Chart 7.3) have a more integrated minority population. A small amount of Census blocks contain high amounts of minority populations. A decent amount of Census blocks, however, contain a minimal minority population (less than 10%). This shows that while minorities that live in these districts are fairly-well integrated with some degree of white population, these districts still contain significant amounts of an isolated white population.

Prince George's County's racial distribution also correlates with zoning density. Unlike Montgomery County, Prince George's County's minority population outnumbers its white population in all classes of zoning districts. Table 7.2 shows the racial composition of each of the zoning classes in Prince George's County. Over 100,000 minority residents live in each the low-density, medium-density and high-density classes of zoning districts. Whites make up less than half of the minority population in each residential zoning district. Only in protective zoning districts do white populations near minority populations. Black populations are high in low, medium and high-density districts. Hispanic populations are much higher in medium and high-density zoning districts than in the low and very-low-density districts.

TABLE 7.2 – Racial/ Ethnic Composition - P.G. County

Generalized Zoning (Res. Zoning Only)	Number Blocks	Area (Acres)	Total Population	Black Population	Hispanic Population	White Population	Minority Population
Very Low Density	142	17,042	18,289	12,772	349	4,107	14,288
Low Density	1,481	81,148	162,005	92,493	5,568	54,629	109,438
Medium Density	3,825	52,709	362,354	229,262	23,295	98,114	272,149
High Density	576	8,448	168,870	120,751	21,734	27,250	151,161
Protective	668	119,034	39,437	18,660	2,253	16,483	23,762
TOTALS	7,651	313,513	801,327	502,540	57,043	216,575	606,644

Data Source: U.S. Census 2000, Maryland Department of Planning

CHART 7.4 – P.G. County

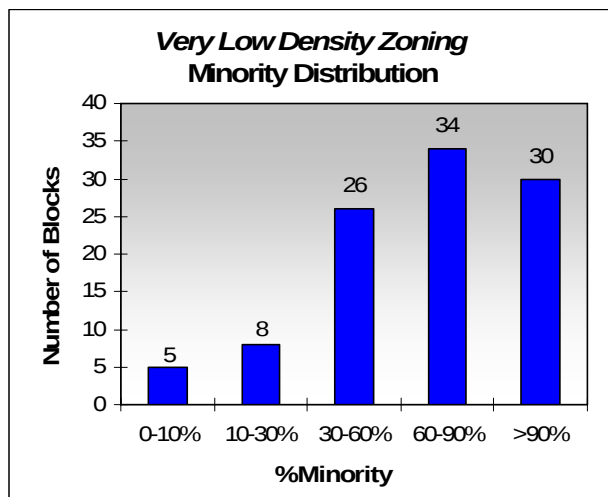
Data Source: US Census 2000; Maryland Department of Planning

Chart 7.4 shows that racial distribution is mostly consistent with zoning density. Other than very-low-density districts, minority populations increase across zoning densities. The very-low-density districts contain a higher than expected minority population. These districts, however, make up a small proportion of Prince George's County – only 142 Census blocks were assigned to very-low-density districts, and only about 2% of the county's population resides in these districts. Most of the minority population in very-low-density districts consists of blacks.

In fact, there are only 349 Hispanics residing in these districts. Hispanic proportions increase across all zoning densities, including the very-low-density district. Other than the very-low-density districts, black population also increases with zoning density.

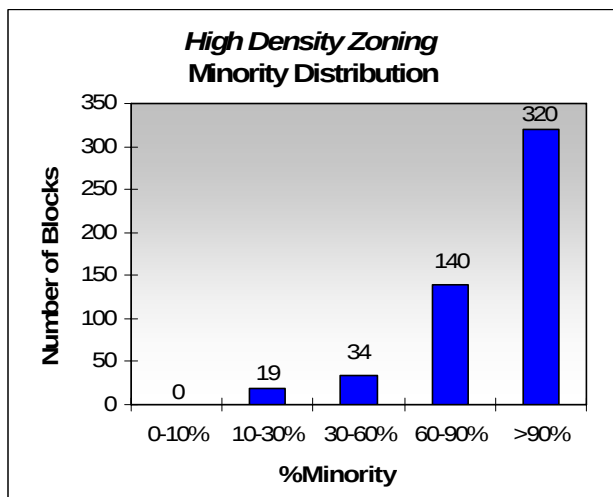
Charts 7.5 and 7.6 show how the minority population is distributed within two zoning density classes: high density and very-low density. Both zoning classes contain high minority proportions – very-low-density districts are about 80% minority, while high-density districts are made up of about 90% minorities. In very-low-density districts, most Census blocks contain a moderate to high (30-90%) minority proportion. Fewer minorities in this zoning class reside in Census blocks with minority populations over 90%. Clusters of minority population are more common in high-density districts where an overwhelming majority of Census blocks have a minority population greater than 90%. Thus, while very-low-density zoning districts prevent minority settlement in some instances, in Prince George’s County, these districts accommodate many minorities that live at more integrated levels.

CHART 7.5
Prince George's County



Data Source:US Census 2000; Maryland Department of Planning

CHART 7.6
Prince George's County



Data Source:US Census 2000; Maryland Department of Planning

Proximity to Industrial Zoning

Racial distribution in Montgomery and Prince George’s County are not only consistent with residential zoning districts, but areas near industrial districts also correlate with racial composition. Table 7.3 shows Census blocks within 100 meters of industrial zoning districts in Montgomery County. Although blacks only make up 15% of the county’s total population, blacks comprise over 20% of the population in Census blocks near industrial zoning districts.

The overall minority population is much higher near industrial zoning as well. Across Montgomery County, whites outnumber minorities, but near industrial zoning districts, the minority population is slightly larger than the white population.

TABLE 7.3 – Montgomery County

Census Blocks within 100 Meters of Industrial Zoning										
Zoning Density	Area (Acres)	Total Population	Black		Hispanic		Minority		White	
			Total	%	Total	%	Total	%	Total	%
Very Low	4,956	2,362	285	12%	196	8%	844	36%	1,518	64%
Low	6,292	21,358	2,860	13%	1,690	8%	8,986	42%	12,372	58%
Medium	2,780	14,820	2,548	17%	1,650	11%	6,853	46%	7,967	54%
High	1,569	15,592	5,489	35%	2,162	14%	10,407	67%	5,185	33%
All Zoning	15,597	54,132	11,182	21%	5,698	11%	27,090	50%	27,042	50%
Entire County	324,548	873,341	132,256	15%	100,604	12%	354,023	41%	519,318	59%

Data Source: U.S. Census 2000, Maryland Department of Planning

Similar trends are seen in Prince George's County. Table 7.4 shows Census blocks near industrial zoning districts in Prince George's County. Like Montgomery County, Prince George's County has higher proportions of blacks and minorities in blocks near industrial zoning than throughout the county as a whole. Prince George's County has much more land devoted to industrial zoning, and the population living near these districts is greater than in Montgomery County. Although the two counties have similar total populations, Prince George's County has about two and one-half times more people residing near industrial zoning districts than Montgomery County. This is not surprising considering that Prince George's County contains a much higher minority population than Montgomery County.

TABLE 7.4 – P.G. County

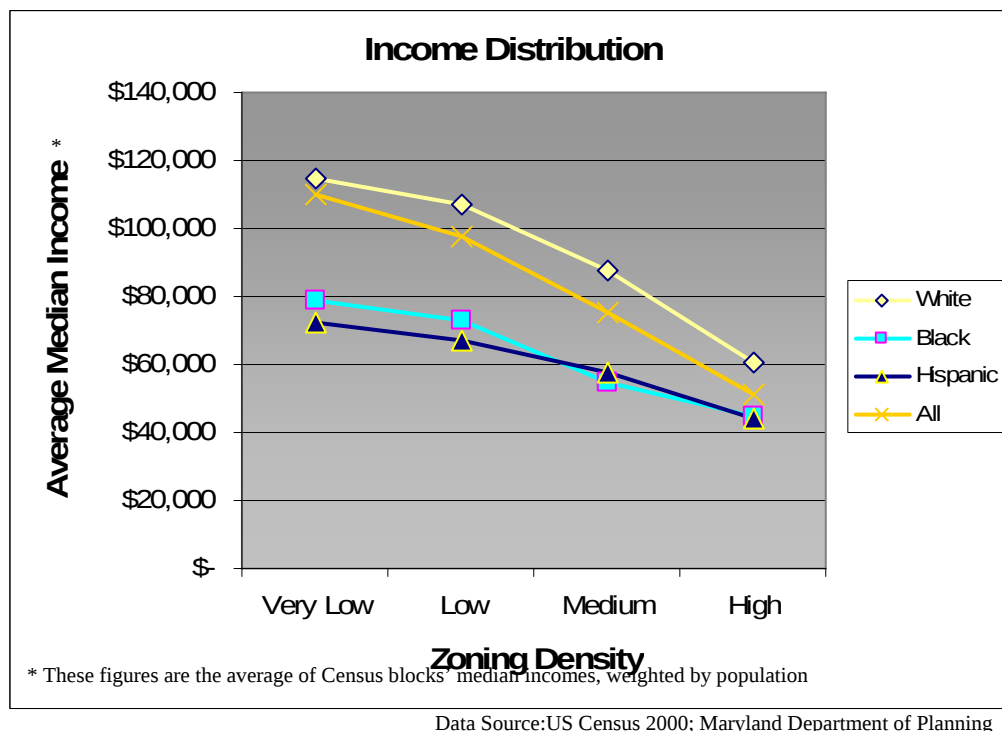
Census Blocks within 100 Meters of Industrial Zoning									
Zoning Density	Total Population	Black		Hispanic		Minority		White	
		Total	%	Total	%	Total	%	Total	%
Very Low	1,559	787	50%	35	2%	1,009	65%	550	35%
Low	22,118	13,425	61%	629	3%	15,522	70%	6,596	30%
Medium	61,784	46,775	76%	1,993	3%	51,599	84%	10,185	16%
High	21,051	17,273	82%	1,039	5%	19,667	93%	1,384	7%
Totals	137,056	95,691	70%	5,304	4%	108,711	79%	28,345	21%
Entire County	801,327	502,540	63%	57,043	7%	606,644	76%	194,683	24%

Data Source: U.S. Census 2000, Maryland Department of Planning

Income Distribution

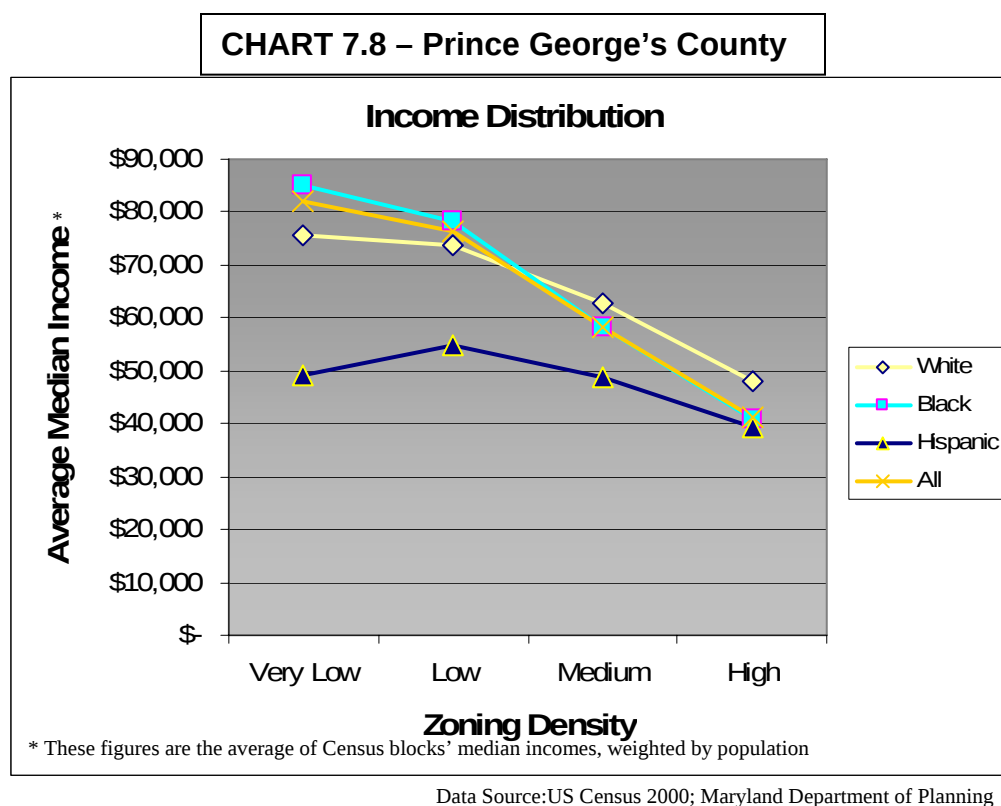
Income distributions in Montgomery and Prince George's County vary across zoning districts similar to variations in racial distribution. Chart 7.7 shows the average of Montgomery County's Census block's median household incomes across each zoning-density class. The chart shows that whites, blacks, Hispanics and the total population all see decreases in income across each increase in zoning density. Hispanics and blacks have much lower incomes than whites in all zoning-density classes in Montgomery County. The highest income blacks and Hispanics reside in low and very-low-density zoning districts. In Montgomery County, blacks and Hispanics make up a minimal proportion of the population within these two low-density zoning classes. Income trends show that the small amount of minorities that are able to reside in these low-density zones have higher incomes than most minorities within the county. Thus, while the low-density and very-low-density districts have fewer minorities, they have even fewer poor minorities.

CHART 7.7 – Montgomery County



The income distribution in Prince George's County similarly varies across class of zoning density. Chart 7.8 shows that incomes of blacks, whites and the total population decrease with each increase in zoning class. Hispanic incomes decrease across each class other than a slight

increase from very-low to low-density zoning districts. Although Prince George's County has a high proportion of blacks in its low and very-low density zoning districts, these blacks on average have much higher incomes than other minorities in the County. In fact, blacks in these lowest density zoning districts make more money than whites in these districts and across the county as a whole. So, while very-low density zoning districts facilitate large proportions of black population, they do not accommodate many low-income blacks. Rather, low-income blacks are more common in medium and high-density zoning districts where black household incomes are less than \$60,000 on average.



In comparing Prince George's income distribution to that of Montgomery County, we see much higher incomes in Montgomery County, particularly among whites. Whites in the two lowest-density zoning classes in Montgomery County have median household incomes over \$100,000, while in the same classes in Prince George's County, whites make less than \$80,000. The white clustering occurring in the low and very-low-density districts in Montgomery County are isolated from large amounts of minorities, but it also appears that they are separated from low-income whites who are more likely to locate in Prince George's County or in higher-density

zoning districts in Montgomery County. Although Montgomery County has an overall wealthier population, blacks in the two low-density zoning classes make more money in Prince George's County than in Montgomery County. While a large number of blacks have been able to locate in these low-density districts in Prince George's County, these blacks have some of the highest household incomes of the black population throughout the D.C. MSA.

HOUSING STOCK ANALYSIS

The housing stock of Montgomery and Prince George's County resembles the densities permitted by each class of zoning district. Montgomery County's housing density directly correlates with zoning density. Table 7.5 shows that as zoning density increases, housing density increases. Although most of the housing densities fall below the range of maximum densities permitted in each zoning-density class, they are all near the range of maximum densities permitted. These housing densities most likely fall below permitted densities due to undeveloped land and land dedicated to streets and other public uses rather than lower built densities. If these lower densities are attributed to vacant land, Montgomery County's housing stock adequately reflects the densities permitted within each class of zoning density.

TABLE 7.5 – Montgomery County Housing Density

Zoning Density	Area (Acres)	Housing Units	Housing Density
Very Low	85,102	28,838	0.34
Low	56,533	83,978	1.49
Medium	30,865	106,545	3.45
High	4,753	42,393	8.92
Totals	177,254	261,754	1.48

Data Source: U.S. Census 2000, Maryland Department of Planning

Housing density in Prince George's County also increases with transitions to higher-density zoning districts. Table 7.6 shows housing densities of less than an acre in the two lowest density zoning density classes, while medium-density zoning districts have housing densities of over 2.5 units per acre and high-density districts have densities of nearly 9 units per acre. Although these densities directly correlate with zoning density, the housing densities are lower than permitted housing densities in each zoning class. Compared to Montgomery County, Prince George's County has lower housing densities in each zoning density class. These lower densities

could be due to higher levels of undeveloped land in the county. Some of the low density could also be attributed to a development pattern that is consistently less dense than the maximum density permitted by each zoning district. Relative to each zoning density class, however, Prince George's County's housing density reflects the different levels of density permitted by each class.

TABLE 7.6 – Prince George's County Housing Density

Zoning Density	Area (Acres)	Housing Units	Housing Density
Very Low	17,042	6,604	0.39
Low	81,148	53,379	0.66
Medium	52,709	133,925	2.54
High	8,448	72,316	8.56
Totals	159,347	266,224	1.67

Data Source: U.S. Census 2000, Maryland Department of Planning

Since both Montgomery County and Prince George's County have housing densities that are consistent with the densities permitted by zoning districts, it can be concluded that housing development is occurring based on zoning regulations. The effect that zoning has on the counties' housing stocks could be influencing the correlation between minority populations and zoning density.

These zoning-density classes in Montgomery County and Prince George's County do not consider the housing types permitted in each zoning district. The assumption would be that the low-density districts only permit single-family housing units, while medium-density zoning districts may also permit some other forms of housing districts such as duplexes, townhouses, and in some cases multi-family housing units, and high-density districts would permit multi-family housing. The fact that racial distribution is so closely correlated with zoning density in these counties would support these assumptions. Since minorities require more multi-family housing than non-minorities, and since minorities reside more frequently in the high-density districts, it would be assumed that high-density districts permit multi-family housing to a greater extent than the other zoning density classes.

Table 7.7 shows home-ownership rates in Montgomery County. Consistent with expectations, home-ownership rates are by far lowest in high-density zoning districts. Home-ownership rates decline slightly from very-low to low-density districts and to a greater extent

from low-density to medium-density zoning districts. This second decline most likely occurs because medium-density areas offer more housing types such as duplexes and/or townhouses. Ownership rates fall drastically from medium-density to high-density districts. This drop indicates that high-density areas are most likely comprised of a large amount of multi-family housing, while medium-density districts contain very few multi-family housing developments.

TABLE 7.7 – Montgomery County Home-Ownership

Zoning Density	Housing Units	Owner-Occupied	Renter-Occupied	Occupied	Vacant	Vacant-For Sale	Vacant-For Rent
Very Low	28,838	92%	8%	98%	2%	29%	9%
Low	83,978	84%	16%	98%	2%	21%	27%
Medium	106,545	73%	27%	97%	3%	25%	28%
High	42,393	28%	72%	96%	4%	9%	50%
Entire County	334,632	69%	31%	97%	3%	20%	35%

Data Source: U.S. Census 2000, Maryland Department of Planning

Prince George's County shows similar home-ownership trends across zoning density classes. Table 7.8 shows that the majority (86% and 87%, respectively) of the population owns their home in the very-low and low-density zoning districts. Fewer households living in the medium-density districts own their homes, and far less own homes in high-density areas. Again, the significant difference between medium and high-density zoning districts is indicative of the agglomeration of multi-family housing developments in high-density districts and the scarce amount of multi-family housing units in medium-density districts. Based on these home-ownership rates, medium-density zoning districts most likely have many single-family, duplex and townhouse units.

TABLE 7.8 – Prince George’s County Home-Ownership

Zoning Density	Housing Units	Owner-Occupied	Renter-Occupied	Occupied	Vacant	Vacant-For Sale	Vacant-For Rent
Very Low	6,604	86%	14%	96%	4%	36%	11%
Low	53,379	87%	13%	96%	4%	41%	12%
Medium	133,925	73%	27%	95%	5%	33%	24%
High	72,316	24%	76%	93%	7%	13%	61%
Entire County	302,294	62%	38%	95%	5%	26%	35%

Data Source: U.S. Census 2000, Maryland Department of Planning

In both counties, these zoning density classes have home-ownership rates similar to the aggregated zoning types (single-family, duplex/ townhouse, multi-family) analyzed in Washington, Alexandria and Frederick. Home-ownership rates in high-density areas (less than 30% in both cases) are similar to Frederick’s, Alexandria’s and Washington’s ownership rates (39%, 22% and 21%, respectively) in multi-family districts. Medium-density districts have ownership rates slightly higher than the townhouse/ duplex districts in Frederick, Alexandria and Washington. Home-ownership rates in these districts in Frederick, Alexandria and Washington are 69%, 58% and 54%, respectively. The higher home-ownership rates in medium-density districts in Montgomery County and Prince George’s County (73% in both cases) most likely indicates that medium-density districts in these counties are made up of more single-family housing units than located in the townhouse/ duplex districts of Frederick, Alexandria and Washington. The lower rate than seen in these counties’ low-density districts indicates that there is some variety of housing type in medium-density districts. Low and very-low-density districts have high home-ownership rates that compare with or exceed the ownership rates of single-family districts in Frederick, Alexandria and Washington. This low rate of ownership confirms that the majority of housing units in low and very-low-density districts are single-family dwelling units.

SUMMARY

Although this analysis cannot consider the individual zoning districts within Montgomery and Prince George’s County, the analysis of zoning-density class showed a high correlation

between zoning density and racial distribution. Both counties, especially Prince George's County, contain some minority residents and minority clustering in very-low and low-density zoning districts. In Prince George's County, however, this minority population mainly consists of high-income blacks that can afford somewhat higher housing costs. In Montgomery County, blacks and Hispanics make up a small proportion of the minorities in these low-density zoning classes. Also, this minority population is much smaller than in higher-density zoning densities, particularly in Montgomery County. So, while the low and very-low-density districts do not restrict minority settlement, these districts tend to have lower minority populations that have different characteristics than other minorities residing in these suburban counties. Low-density districts, especially in Montgomery County, contain large numbers of whites, many of which are isolated from black and Hispanic populations.

Medium and high-density zoning districts much better accommodate minorities, particularly lower-income minorities. Minority clustering and minority populations are most prevalent in these two higher-density zoning classes. In both counties, minority proportions are greatest in high-density districts. Based on housing density and home-ownership rates, these high-density districts are the only locations where multi-family housing units are widely available. These districts also have a housing stock of about three to four times greater density than found in any of the other zoning classes.

CHAPTER 8: CROSS-JURISDICTIONAL COMPARISON

Much of the literature regarding zoning and racial segregation has focused on the effect that zoning has on racial and ethnic distribution across jurisdictions. Most studies have shown that suburban localities that have little residential land devoted to anything other than single-family use have lower minority populations (Ihlanfeldt, 2004; Danielson, 1976; Thomas, 1994, De Souza Briggs, 2005). Recently, many minorities have been able to locate in suburban jurisdictions. Since 1970, more blacks and minorities have located in suburbs. Many of these minorities, however, are no less segregated than minorities in the central city. Darden and Kamel (2000) found that although blacks in the Detroit MSA are highly segregated in both suburbs and the central city, suburban blacks are more segregated than central city blacks.

If zoning ordinances in the Washington, D.C. MSA are connected to racial distribution, we would expect to see more low-density zoning in localities with lower minority populations, and we would expect to see higher minority populations in jurisdictions in which high-density, multi-family zoning is more widespread. In this chapter, I compare minority populations and recent population change in each locality within the study area. Then, the area of residential zoning districts of each locality are examined. Finally, after considering minority populations and residential zoning areas, I compare segregation indices of each community in an effort to examine the evenness, concentration and interaction (or lack thereof) of minority populations in each locality.

DEMOGRAPHICS

Table 8.1 shows that in 1990, Washington, D.C. had the highest proportion of blacks and overall minority population of any of the localities within the study area. The central city's minority population comprised over 70% of the city's total. Washington's black population made up the majority of this minority population, while Hispanics only made up a small portion of this population. Other than Prince George's County, black populations in the study area's other locations were substantially lower. Although Hispanic populations were near those in D.C., overall minority populations were much lower in these locations, particularly Montgomery

County and Frederick. In 1990, these two suburban locations had a population made up of fewer than 30% minorities despite the study area's overall minority proportion of 50%.

TABLE 8.1 – 1990 Populations

Location	Total Population	Black		Hispanic	
		Population	Percent	Population	Percent
Washington DC	606,900	399,604	66%	32,710	5%
Alexandria, VA	111,183	24,339	22%	10,778	10%
Montgomery County, MD	757,027	92,267	12%	55,684	7%
Prince George's County, MD	729,268	369,791	51%	29,983	4%
Frederick, MD	40,148	5,151	13%	847	2%
Totals	2,244,526	891,152	40%	130,002	6%

Location	Total Population	White		Minority	
		Population	Percent	Population	Percent
Washington DC	606,900	159,178	27%	440,769	73%
Alexandria, VA	111,183	68,889	64%	39,697	36%
Montgomery County, MD	757,027	548,453	72%	208,574	28%
Prince George's County, MD	729,268	303,090	42%	426,178	58%
Frederick, MD	40,148	39,644	83%	6,828	17%
Totals	2,244,526	1,119,254	50%	1,122,046	50%

Data Source: U.S. Census 1990

Although there were many demographic changes, populations in 2000 had similar trends across the study area. Table 8.2 shows that the highest black and minority populations were found in Washington and Prince George's County. By 2000, Prince George's County had surpassed Washington in black and minority population. In 2000, minorities made up over three-quarters of the population in Prince George's County with blacks being the dominant minority group. Frederick and Montgomery County still had the lowest minority populations although minority proportions rose to 25% and 41% of the area's total populations, respectively. Black populations in these two locations, however, remained small as both localities were comprised of approximately a 15% black population. In 2000, Alexandria and Montgomery County contained the highest Hispanic populations. These are the only locations within my study area that contain a Hispanic population making up at least 10% of the area's total population. Based on these low black and overall minority populations in Frederick and Montgomery County, we would expect to see larger amounts of land dedicated to single-family, low-density zoning in these two locations than in other study area locations.

TABLE 8.2 – 2000 Populations

Location	Total Population	Black		Hispanic	
		Population	Percent	Population	Percent
Washington DC	572,059	343,312	60%	44,953	8%
Alexandria, VA	128,283	28,915	23%	18,882	15%
Montgomery County, MD	873,341	132,256	15%	100,604	12%
Prince George's County, MD	801,327	502,540	63%	57,043	7%
Frederick, MD	52,843	7,777	15%	2,533	5%
Totals	2,427,853	1,014,800	42%	224,015	9%

Location	Total Population	White		Minority	
		Population	Percent	Population	Percent
Washington DC	572,059	159,178	28%	412,881	72%
Alexandria, VA	128,283	68,889	54%	59,394	46%
Montgomery County, MD	873,341	519,318	59%	354,023	41%
Prince George's County, MD	801,327	194,683	24%	606,644	76%
Frederick, MD	52,843	39,644	75%	13,199	25%
Totals	2,427,853	981,712	40%	1,446,141	60%

Data Source: U.S. Census 2000

Minority suburbanization, particularly black suburbanization increased during the second half of the twentieth century, occurring at much greater rates since the 1970s (Nelson 1978; Nelson 1980; Connolly 1973; Logan and Schneider 1984). Population change from 1990 to 2000 in the Washington, D.C. MSA confirms this trend (Table 8.3). The central city was the only location within the study area that experienced a loss in overall population. A major portion of this population loss came from a decrease in the black population, which declined by 14% during the ten-year period. Much of this black population migrated out to suburban locations in Montgomery and Prince George's County. Black populations rose by 36% in Prince George's County and 43% in Montgomery County. Considering that Prince George's County already had a substantial black population in 1990, this 36% increase resulted in a large increase of 132,000 in the county's total black population. Hispanic population increased at high rates in all locations within the study area, but this growth occurred at the greatest rates in the locations outside the central city. Montgomery County absorbed the largest total number in Hispanic population growth. The Hispanic population grew by nearly 45,000 from 1990 to 2000. Frederick experienced the highest minority population growth rate. During only a ten-year span, the city's minority population nearly doubled. The highest absolute minority growth occurred in Prince George's County, which gained about 180,000 minority residents.

TABLE 8.3 – 1990-2000 Population Growth

Location	Total Population	Black Population	Hispanic Population	White Population	Minority Population
Washington, DC	-6%	-14%	37%	-4%	-6%
Alexandria, VA	15%	19%	75%	-4%	50%
Montgomery County, MD	15%	43%	81%	-5%	70%
Prince George's County, MD	10%	36%	90%	-36%	42%
Frederick, MD	32%	51%	199%	0%	93%
Study Area	8%	14%	72%	-13%	29%

Data Source: U.S. Census 1990, 2000

Alexandria, Montgomery County and Frederick all had relatively small minority populations in 1990, but minority populations in each of these locations grew by over 50% in the next ten years. Prince George's County gained more minorities than these three locations combined. This high minority population growth is most likely occurring in many zoning types, but it would be highly unlikely that such dramatic minority growth could occur without the availability of much medium and high-density zoning.

ZONING AND MINORITY POPULATION

Table 8.4 shows land area by zoning type. Since types of residential dwelling units were not considered in the aggregated zoning-density classes used for Montgomery and Prince George's County, I converted zoning density to zoning type based on the home-ownership rates within the zoning-density classes².

As seen in Table 8.4, Washington, Alexandria and Frederick have the highest amounts of land dedicated to multi-family use. Multi-family zoning makes up less than 10% of the residentially-zoned land within Prince George's and Montgomery County. These counties cover vast areas, many of which are quite distant from the central city and zoned for low-density use. It is not surprising that these two counties have higher amounts of land designated for low-density uses and less land devoted to multi-family zoning districts. A comparison of

² Both the low and very-low-density zoning classes in the two counties have higher home-ownership rates than most of the single-family zoning districts in the study area and will consequently be defined as single-family for the purposes of this comparison. Medium-density districts had ownership rates lower than single-family districts but slightly higher than most of the townhouse districts within the study area. Medium-density districts most likely contain some single-family zoning districts, but for the purposes of this study, I will assume that the medium-density class is more consistent with the townhouse/ duplex zoning types. High-density districts have ownership rates consistent with multi-family districts elsewhere in the study area and will be defined as multi-family districts for this comparison.

Montgomery County and Prince George's County reveals that Prince George's County contains far more land devoted to higher-intensity residential uses. The proportion of land devoted to multi-family zoning is three times greater in Prince George's County than in Montgomery County. The proportion of Townhouse/ duplex zoned land in Prince George's County nearly doubles the proportion of Montgomery County. Prince George's County also has about 15% less of its land devoted to single-family zoning districts.

This composition of zoning districts in these two counties is expected because Prince George's County has a much higher minority population, particularly a much higher black population than Montgomery County. The abundance of higher-density, multi-family and townhouse/ duplex zoning districts is consistent with a greater amount of blacks and minorities in Prince George's County.

TABLE 8.4 – Land Area by Zoning Type

Percent of Land Area Devoted to Zoning Type					
Zoning Type	Washington	Alexandria	Frederick	Prince George's County	Montgomery County
Single-Family	25%	30%	24%	30%	45%
Townhouse/ Duplex	12%	15%	13%	15%	9%
Multi-Family	15%	14%	10%	3%	1%
Mixed Use	1%	19%	13%	1%	1%
Commercial	7%	7%	13%	5%	1%
Other	41%	16%	27%	46%	42%
Totals	100%	100%	100%	100%	100%

Percent of Residential-Zoned Land Devoted to Zoning Type					
Zoning Type	Washington	Alexandria	Frederick	Prince George's County	Montgomery County
Single-Family	48%	51%	51%	62%	81%
Townhouse/ Duplex	23%	25%	28%	32%	17%
Multi-Family	29%	24%	21%	6%	2%
Totals	100%	100%	100%	100%	100%

U.S. Census 2000; City of Washington, City of Alexandria, City of Frederick, Maryland Planning Department

Montgomery County is not without these high-density zoning districts and has experienced widespread minority settlement, including rapid minority population growth in the last ten years. A potential factor influencing rapid minority population growth in Montgomery County is the county's inclusionary zoning ordinance requiring affordable housing. All new

developments (in any zoning district) over 35 units in size must include affordable housing units. This requirement assures that affordable housing is becoming increasingly available. As affordable housing becomes more widespread, greater numbers of low-income minorities will be able to locate in Montgomery County.

The three cities (Washington, Alexandria and Frederick) also show some variation in the amount of land designated to each zoning type. Washington offers the highest proportion of land as multi-family zoning. When looking at only residentially-zoned land, Washington also offers the least amount of single-family zoning. Alexandria and Frederick both restrict over one-half of its residentially-zoned land to single-family use only. The higher amount of high-intensity residential zoning in Washington is expected because Washington is the central city and has much higher proportions of black and overall minority populations.

Alexandria and Frederick both offer slightly more townhouse/ duplex zoning than Washington. Frederick actually contains more townhouse/ duplex zoning than Alexandria. Frederick's one zoning district in this category, however, permits only duplexes, not townhouses, while most of Alexandria's zoning districts in this category permit townhouses. Alexandria also offers more multi-family zoning than Frederick. Alexandria has more land devoted to higher-intensity residential uses, which is expected based on the two locations' proximity to Washington and based on the racial and ethnic composition of each city. Alexandria's population is made up of 46% minorities, while Frederick's minority population only makes up 25% of the city's total population. Alexandria's black and Hispanic populations also exceed those of Frederick. The amount of land designated to each zoning type in these three cities and the two counties is consistent with the racial and ethnic composition of each city. The cities or counties with the highest proportion of land zoned for multi-family uses also have higher minority populations. Conversely, those cities and counties offering the least multi-family zoning have the lowest minority populations.

SEGREGATION

Although minority populations are highest in the central city and in suburbs with the highest amount of land regulated by multi-family zoning districts, this finding says nothing about the segregation that occurs in these different places. I examine segregation indices in Table 8.5 to understand the levels of segregation in each of these places. Each of these indices shows that black-white and minority-white segregation is most severe in Washington. Blacks and whites

show the least interaction, blacks are more isolated, and the black population is less evenly distributed in Washington than in any of the surrounding study area locations. These trends support studies claiming that central city segregation is more severe than segregation in suburbs (Alba and Logan, 1993). These trends are also consistent with the notion that white flight leaves behind a highly-segregated central city (Powell, 1998; Taeuber, 1975).

TABLE 8.5 – Segregation Indices

Location	Dissimilarity Index			Interaction Index		
	Black	Hispanic	Minority	Black-White	Hispanic-White	Minority-White
Washington	0.750	0.560	0.770	0.139	0.251	0.115
Alexandria	0.398	0.475	0.519	0.350	0.310	0.356
Montgomery	0.480	0.448	0.444	0.394	0.406	0.437
Prince George's	0.494	0.443	0.498	0.247	0.344	0.276
Frederick	0.386	0.445	0.364	0.612	0.621	0.631

Location	Isolation Index				Concentration Index	
	Black	Hispanic	White	Minority	Black	Hispanic
Washington	0.715	0.288	0.702	0.885	0.503	0.693
Alexandria	0.375	0.327	0.709	0.644	0.584	0.611
Montgomery	0.313	0.257	0.730	0.563	0.758	0.758
Prince George's	0.642	0.167	0.608	0.724	0.715	0.831
Frederick	0.270	0.123	0.806	0.369	0.635	0.659

Data Source: US Census 2000; Maryland Department of Planning, City of Alexandria, City of Frederick, City of Washington

After Washington, Prince George's County shows the next highest levels of black-white segregation, while black-white segregation is lowest in Frederick. The high segregation in Prince George's County confirms the conclusions of the literature that black segregation in suburbs often occurs at rates similar to those in central cities (Stahura, 1983; Logan and Schneider, 1984). Prince George's County has received the largest amount of black suburbanization in D.C. The high segregation indices point out that this suburbanized population is nearly as segregated as the black population in Washington.

Segregation indices for Hispanics show that Hispanics are also most segregated in Washington, but the levels of segregation are not much lower in Alexandria, which contains the largest proportion of Hispanic residents of any location in the study area. Hispanic segregation throughout the study area is significantly lower than black segregation, but some Hispanic segregation remains nonetheless. It is occurring most where Hispanic populations are highest. Although many Hispanics are suburbanizing, these Hispanics are remaining fairly segregated.

SUMMARY

Minority populations have settled and continue to settle at different rates in each of the localities within the study area. The relative amounts of minority residents, particularly black residents, in each of these locations are consistent with the amounts of multi-family zoning within each area. Prince George's County has much higher black and minority populations than Montgomery County. It also has three times as much of its land devoted to multi-family zoning. Montgomery County's minority population has grown rapidly since 1990 despite its low instance of multi-family zoning. This minority population growth could be fueled in large part by the county's inclusionary zoning ordinance that gives density bonuses in return for providing a required amount of affordable housing units. Although minority populations are increasing in suburban locations such as Prince George's and Montgomery County, black segregation remains high in the suburbs, particularly in Prince George's County. Even though more abundant multi-family zoning may be encouraging black suburbanization, which in turn lessens the broader pattern of segregation in the MSA, local segregation still remains high.

CHAPTER 9: CONCLUSION

This study has shown that for all locations within the study area, minority populations are correlated with zoning districts. Although the level of correlation varies from jurisdiction to jurisdiction, the type and density of housing permitted by zoning districts had some degree of correlation with each location's racial and ethnic population. This chapter will summarize the key findings of this report, consider possible solutions to lessen zoning's impact on racial and ethnic population distribution and segregation, and discuss the potential and need for further research of this kind.

SUMMARY OF FINDINGS

Zoning exhibited some degree of correlation with minority population distribution in all the locations within my study area. In general, minority populations are higher in multi-family and high-density zoning districts, while white populations are higher in single-family and low-density zoning districts. Minority clustering is more common in high-density zones that permit multi-family zoning, while white isolation more frequently occurs in low-density zoning districts that prevent the establishment of multi-family housing. Zoning, however, is not always consistent with these areas of clustering. In many instances, clusters of high-income minorities were abundant in single-family zoning districts.

Zoning's correlation with minority populations is greatest in fast-growing communities. Each of the locations in this study, other than Washington, D.C., grew in total population and minority population from 1990 to 2000. It is not surprising that Washington exhibited the lowest levels of connection between zoning and racial population distribution. Washington is characterized by an east-west population divide, in which whites occupy a majority of the western portion of the city and minorities occupy most of the eastern half of the city. This divide does not directly coincide with zoning – there are high-density, multi-family districts in the western half, while there are many single-family zoning districts in the eastern half of the city.

Zoning, however, could play a role in maintaining this divided population. The western half of the city has more land devoted to single-family zoning, while the eastern half of the city has more land designated as multi-family zoning districts. The abundance of single-family zoning, particularly the R-1-A district, in the western half of the city reduces the amount of high-density and multi-family housing, which could be reducing the amount of minorities that are able

to relocate to the western half of the city. The R-1-A district's low minority population and high number of Census blocks with a minority population under 10% shows that blacks have not been as successful in relocating to this low-density zoning district.

Although minorities typically prefer to reside in communities with other members of the same ethnic/ racial group, this preference is much stronger among whites (Clark, 1992). Emerson et al. (2001) found that whites are much less likely to purchase a home if the neighborhood has an established black population. In an evaluation of recent literature, Dawkins (2004) found that both blacks and whites prefer to live among their own race, but this preference is typically stronger among whites. Considering that blacks' own-race preference is lower, blacks would be more likely to pursue residential opportunities in Washington's western half than whites would be to pursue housing in the mostly-black eastern half of the city. Racial preference and low-density zoning in the city's western half could be two of several forces that have prevented large numbers of blacks from relocating to the city's western half. The result is a persisting pattern of racial segregation.

Prince George's County also has an established black population. In Prince George's County, more blacks and minorities overall reside in higher-density zoning districts that permit a wider array of housing types. There is some disparity, however, because a large proportion of blacks reside in the lowest-density zoning districts in the County. Despite this disparity, zoning does show some correlation with the racial distribution of the county. Very-low density zoning districts contain small pockets of white population in the fringes of the county. Blacks are much less likely to locate in these low-density districts where a largely-white population exists.

Very-low density zoning does not prevent black settlement in other parts of the county that are near established black neighborhoods. In these areas, zoning correlates more with income class than with racial distribution. Fischer (2003) found that income segregation increased during much of the latter part of the twentieth century, while racial segregation slightly decreased. This income differentiation across zoning densities is particularly apparent in Prince George's County. Wealthy blacks have sorted themselves into low and very-low-density zoning districts in which the median black income surpasses median white incomes. Meanwhile, low-income blacks mainly reside in higher-density districts where rental housing and affordable housing is more widely available. These blacks are also less integrated with the white population. This trend of income segregation is also apparent among blacks in other localities.

In Washington, for example, large amounts of higher-income blacks have located in single-family zoning districts, many of which are located in the eastern half of the city.

In Alexandria, Frederick, and Montgomery County, minority populations are less well established but grew rapidly during the 1990s. Where minority population growth rates are higher, zoning districts are more directly correlated with the minority population. In Alexandria, Frederick and Montgomery County, minority populations are much higher in multi-family districts than in single-family districts. Single-family districts better correspond with the isolation of the white population, while minorities cluster more frequently in multi-family districts. Zoning density is also correlated with minority population distribution, particularly in Frederick where minority populations are growing fastest. The location of these jurisdictions' zoning districts could be influencing the settlement patterns of the highly-growing minority populations in each of these locations. If these zoning ordinances are in fact guiding minorities to settle within the areas that the jurisdiction designates as high-density, multi-family, these jurisdictions are encouraging this growing minority population to become increasingly segregated.

POTENTIAL SOLUTIONS

This study found that minority populations and minority clustering is prevalent in high-density zoning districts. Although this study did not show that zoning is causing minorities to locate in this fashion, it showed that zoning can have inequitable outcomes among different racial and ethnic groups because different zoning districts accommodate different levels of minority population and minority segregation. Because of zoning's housing restrictions, minorities and the low-income population could be locating in areas further from employment centers than they would have otherwise chosen. As localities undergo planning efforts, they should consider how land-use regulations may impact different population groups. Localities need to carefully research the distribution of their populations in regard to land-use regulations and housing opportunities. Comprehensive planning should consider the results from this research and propose strategies to address this issue.

Furthermore, given the negative consequences associated with racial and income segregation, jurisdictions should consider amending their land-use regulations. Zoning and other land-use regulations should have an equitable outcome – an outcome that facilitates and encourages racial and ethnic integration. Although solutions to limit land-use regulations' effect

on racial segregation were not directly explored in the analysis of this report, I discuss potential solutions here based on planning literature and regulations applied in communities across the country.

One method that should be pursued is encouraging and/or requiring the provision of some amount of affordable housing within single-family zoning districts. Affordable housing can be created in single-family districts by permitting duplexes or accessory dwelling units when these units are offered to middle or low-income households. To encourage affordable housing, density bonuses can also be given to projects that produce affordable housing in some of the city's lower-density zoning districts.

The American Planning Association found that mandatory affordable housing requirements yield better results than affordable housing incentives (Brunick, 2004). Inclusionary zoning ordinances such as Montgomery County's ordinance produces higher amounts of affordable housing than incentive-based programs. By requiring that at least 15% of housing units in every new residential project be affordable to the population making less than 65% of the median income (Axel-Lute, 2003), the County has created the potential for affordable housing in every zoning district. Montgomery County's high minority population growth rate during the 1990's illustrates the effectiveness of this land-use tool in fostering higher levels of racial and ethnic distribution.

If affordable housing mandates are going to be the cure for land-use regulations' effects on racial and ethnic segregation, higher levels of government must be involved. Many communities, such as Montgomery County, will be able to take the initiative to establish affordable housing requirements. Other communities, however, will be less inclined to adopt inclusionary zoning ordinances. Many high-income, suburban communities will face substantial opposition to enacting an ordinance that will bring lower-cost housing and low-income residents to the community. This public opposition will often be enough deterrent to prevent the community from passing the ordinance. For example, the Town of Pinetop-Lakeside, Arizona attempted to amend its planned unit development (PUD) ordinance to entice certain developments to build affordable housing units. The Town, a fairly high-income resort town located in Arizona's White Mountains, received considerable complaint from the public. After passing a toned-down version of the ordinance, the public filed a petition for referendum that will likely strike down the new ordinance (Esparza, 2006). Communities such as Pinetop-

Lakeside that have strong public opposition to affordable housing requirements are often the wealthy, suburban communities most in need of affordable housing.

To ensure that all communities require some amount of affordable housing, state governments need to require its counties and municipalities to adopt affordable housing strategies that will result in the construction of a fair amount of new affordable housing. The federal government should either require or encourage states and/or municipalities, through financial assistance, to adopt affordable housing strategies that result in higher-levels of integration of the low-income population. Four states (Rhode Island, Illinois, Massachusetts and Connecticut) have already enacted legislation that requires its municipalities to use various fiscal and/ or regulatory strategies to achieve higher amounts of affordable housing (Meck, 2003). By requiring all communities to enhance and integrate affordable housing, these states have taken a great step toward integrating the low-income and minority population. New affordable housing opportunities in these states will be available in a variety of zoning districts, not just high-density, multi-family districts. By making affordable housing available in all zoning districts, these states will have also reduced zoning's influence on racial and ethnic segregation.

Inclusionary zoning, however, has its drawbacks. Powell and Stringham's (2004) study on inclusionary zoning in the San Francisco Bay area found numerous flaws with inclusionary zoning. The authors found that requiring developers to sell houses at sub-market values causes developers to take a significant financial cut. Much of this cut is passed on to other homes that are selling at market rates. Of the communities in the study, average new housing units sold at a median price increase ranging from \$22,000 to \$44,000. The result is an overall more expensive housing stock with a few price-controlled, affordable housing units. By making the housing market less profitable, inclusionary zoning can also reduce the total number of new units built, resulting in few affordable housing units being built.

These problems associated with inclusionary zoning will not necessarily prevent this land-use policy from being a successful tool in facilitating the integration of low-income and minority residents. To avoid or at least reduce the negatives connected to inclusionary zoning, inclusionary zoning ordinances must be accompanied by density bonuses. Without some form of compensation, the requirement to produce and sell homes below the market rate is unfair to developers and detrimental to the housing market. Providing density bonuses will allow developers to build extra housing units and generate more revenue than originally permitted by

the zoning district. This added revenue should offset at least a part of the cost associated with providing affordable housing, returning the housing market back to equilibrium in the process.

Due to other factors contributing to racial and income segregation, enacting land-use regulations that facilitate integration will not immediately lead to an integrated city. It will, however, remove one institutional barrier to racial and income integration, providing the opportunity to move toward a less segregated pattern of urban development.

FURTHER RESEARCH

Due to time and data limitations, this study was limited to five jurisdictions within the Washington, D.C. MSA. The study was able to show that zoning districts coincide with the residential locations of minority populations within and across these five jurisdictions in the Washington, D.C. MSA, but it did not show that zoning is a cause of racial distribution patterns or racial segregation. This study did not consider the effect that other factors such as housing preference, racial preference, housing discrimination, land values not associated with land regulation, and other items that could be influencing Washington's racial distribution patterns. A well-designed regression model that considers racial change across time could consider some of these factors as well as clarifying zoning's role in determining racial distribution patterns. Moreover, this study analyzes only one metropolitan area. It does not confirm a national pattern of zoning districts correlating with municipality's minority populations.

The results of a study of this kind would be greatly aided by an enlarged, nation-wide study area consisting of several jurisdictions within various MSA's. These studies could even go a step further to analyze other factors involved with the minority population distribution by conducting a regression that draws out some of the determining factors of racial distribution. There are, however, some obstacles to conducting such a study. First, data limitations will prevent the completion of a truly nation-wide study of every large MSA. Many municipalities have zoning data freely available to the public, other municipalities sell zoning data at prices well over one hundred dollars, while other municipalities do not have a readily available zoning shapefile at all. As GIS applications are becoming more and more necessary in the public sphere, however, many municipalities that lack the necessary GIS data will obtain this data.

A second obstacle to a nationwide study is a time constraint. Assigning zoning variables to Census blocks for the City of Washington, D.C. alone took well over forty hours. The

additional work required to prepare the data for analysis was also quite time-consuming. The fact that I only studied five separate jurisdictions enabled me to complete this project over the course of one year. A broader study covering numerous MSA's would require a significantly larger time commitment. The time commitment could be drastically reduced by assigning zoning variables based on Census block centroids, rather than manually assigning a zoning variable to each block. Using this centroid method, however, would add a significant amount of uncertainty to a study that already exhibits a high degree of uncertainty (See appendix).

Although it will be a difficult task, future GIS data improvements will enable a more broad application of this research. More widespread research in this field will verify if the trends observed in this study are unique to the Washington, D.C. MSA or if they accurately represent zoning's impact on racial and ethnic distribution in cities across the nation. Having this type of research completed will help us better analyze our current system of land-use regulations and better approach new methods for encouraging higher levels of racial and ethnic integration. To achieve higher levels of integration, many more societal changes will need to occur, but zoning at a minimum should not be serving as an obstacle for our nation to reach racial and ethnic integration.

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APPENDIX

DATA SOURCES

I acquired 2000 U.S. Census data for all Census blocks within each county studied. The primary unit of analysis in this study is the Census block because this smallest unit of Census geography has the best potential to be overlaid with municipal zoning districts. Although Census tracts and block groups have more data associated with them (SF3 data), the larger size of tracts and block groups make them infeasible for this project. Many Census tracts have multiple zoning districts within the tract. Census blocks are much smaller and more frequently have only one zoning district within their boundaries. In order to conduct a demographic analysis of each zoning district, my study requires as many Census units as possible to have only one zoning district within its boundaries. The Census website provides SF1 (short-form) data for blocks, but it does not provide SF3 (long-form) data. Most of the data needed for this study, including race and ethnicity data, is available from the SF1 form, but income data is only available through the SF3 form. Thus, all analyses of income distribution by zoning district are conducted at the block group level. The following Census variables were used in this study:

SF1 Data:

- P7 – Race (Total Population)
- P8 – Hispanic or Latino by Race (Total Population)
- H1 – Housing Units
- H3 – Occupancy Status (Housing Units)
- H4 – Tenure (Occupied Housing Units)
- H5 – Vacancy Status (Vacant Housing Units)
- P16 – Population in Households
- P16A - Population in Households (White Alone Householder)
- P16B - Population in Households (Black Alone Householder)
- P16H - Population in Households (Hispanic or Latino Householder)
- P16I - Population in Households (White Alone, Not Hispanic or Latino Householder)
- H11 – Total Population in Occupied Housing Units by Tenure
- H11A - Total Population in Occupied Housing Units by Tenure (White Alone Householder)
- H11B - Total Population in Occupied Housing Units by Tenure (Black Alone Householder)
- H11H - Total Population in Occupied Housing Units by Tenure (Hispanic or Latino Householder)

- H11I - Total Population in Occupied Housing Units by Tenure (White Alone, Not Hispanic or Latino)

SF3 Data:

- P53 – Median Household Income in 1999 (Dollars)
- P152A – Median Household Income in 1999 (Dollars) (White Alone Householder)
- P152B - Median Household Income in 1999 (Dollars) (Black Alone Householder)
- P152H - Median Household Income in 1999 (Dollars) (Hispanic Alone Householder)
- P152I - Median Household Income in 1999 (Dollars) (White Alone, Not Hispanic Householder)
- P87 – Poverty Status in 1999 by Age
- P159A – Poverty Status in 1999 by Age (White Alone)
- P159B – Poverty Status in 1999 by Age (Black Alone)
- P159H – Poverty Status in 1999 by Age (Hispanic Alone)
- P159I – Poverty Status in 1999 by Age (White Alone, Not Hispanic)

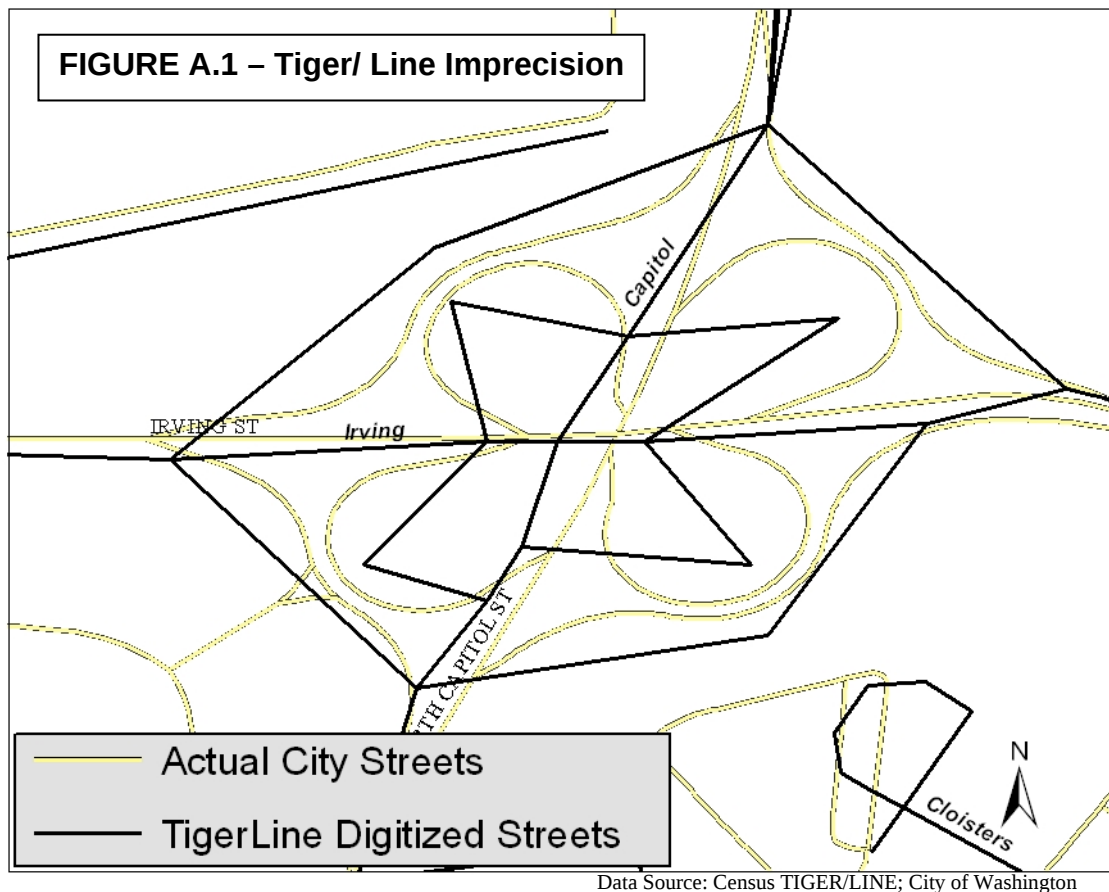
Chapter 2 used additional Census data to give a broader metropolitan-wide population study. For the analyses in Chapter 2, I acquired Census data at the place level. These Census-defined places often represent the geographies of towns and cities. For example, the entire cities of Alexandria and Frederick are represented by one Census-defined place each. In Chapter 2, I utilized the following 1990 SF1 Census data:

- P001 – Persons
- P006 – Race
- P008 – Persons of Hispanic Origin
- P010 – Hispanic Origin by Race

Tiger/ Line shapefiles, provided by the U.S. Census, enable Census data to be applied to a geographic information system (GIS). Tiger/ Line shapefiles include polygons of Census blocks, block groups, tracts, and Census-defined places. There are also shapefiles of streets, hydrology, rail and other features. Although these shapefiles enable Census data to be spatially analyzed against other geographies such as municipal zoning districts, Tiger/ Line shapefiles are limited by the small-scale at which they were digitized. Tiger/Line files were created for a scale of 1:100,000, which is far less precision than needed to accurately align Census blocks with zoning districts.

Figure A.1 shows a Tiger/Line files' imprecise street layer compared to the street layer provided by Washington, D.C. The actual streets, represented by Washington's street layer have

smooth curves, while the imprecisely-digitized Tiger/ Line shapefiles skip these details and merely display a couple straight lines. This imprecision inherent in the Tiger/ Line shapefiles created difficulties in relating zoning districts to the Census geography represented by Tiger/ Line files. This problem will be discussed further in the methodology section of this chapter.



The next important piece of data used in this study are local zoning maps. Washington, D.C., Frederick and Alexandria each supplied me with municipal zoning shapefiles. These shapefiles accurately portray the spatial orientation of the municipalities' zoning districts at the sub-block level. These highly precise and accurate datasets enable me to accurately relate Census data to local zoning districts.

By looking at zoning ordinance text, I associated each zoning district with the type of residential dwelling units permitted in each zone (single-family, duplex, townhouse, and/or multi-family) and the maximum residential density permitted in each zone (number of dwelling

units per acre, minimum lot size or floor-area-ratio). Each jurisdiction's zoning districts and zoning map are discussed in Chapters 4 through 7.

METHODOLOGY

Once all the necessary data was acquired, there were several steps required to conduct the analyses undertaken in this project. First, I had to join Census block data to Tiger/ Line shapefiles. Once the Census data was associated with the block shapefiles, Census blocks were overlaid upon local zoning shapefiles.

My next step entailed associating Census data with a particular zoning district within each jurisdiction. To accomplish this, I had to assign each Census block a zoning variable, corresponding to the zoning district in which it is located. This designation of zoning districts to Census blocks enables a demographic analysis of each zoning district, showing to what extent zoning districts influence racial distribution and racial segregation.

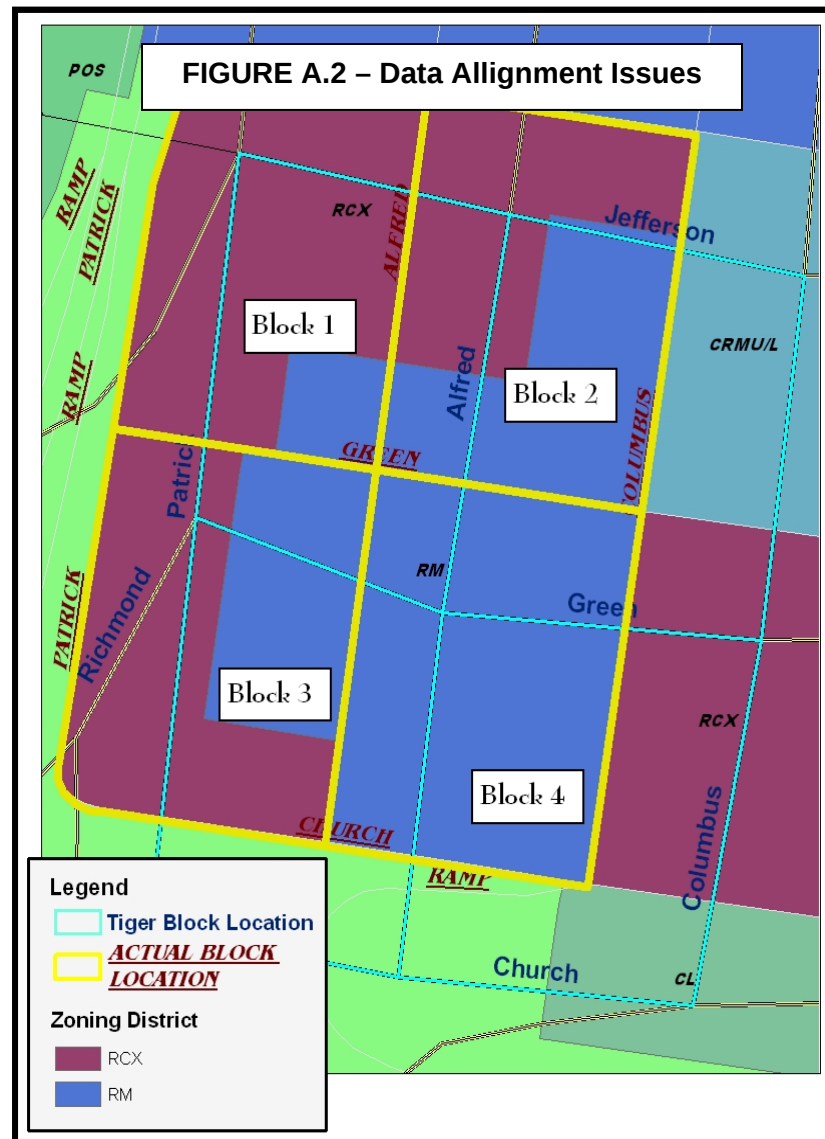
Using ESRI's ArcGIS software, I had numerous options as to the means by which I assigned zoning variables to each Census block. The most obvious option was performing a spatial join on the Census block shapefile and the local zoning shapefile. To do this, I would have converted blocks to centroids and assigned blocks to the zoning district occupying the center of each block. This centroid-spatial join process would have been the quickest and easiest method to assign a zoning district to each Census block. This method, however, has a number of problems associated with it. First, the centroid method only considers one zoning district - the zoning district located at the block's center. It does not necessarily assign the zoning district that occupies the largest area of the Census block. Usually, the zoning at the centroid covers the majority of the Census block's area, but in some instances, other zoning districts cover larger portions of the Census block's area. Another problem with this method is that it does not necessarily capture the majority of the Census block's population. If the center of the block is zoned for commercial use, but a large portion of the block is zoned for residential use, this method would assign a commercial zoning variable to the block even though it is more likely that the residential area contains a higher population. Considering that the main purpose of my study involves demographics, it will be important that my zoning variable assignment method has the best chance to capture the majority of each block's population.

Despite the flaws associated with the centroid-spatial join technique, I used this method for assigning zoning variables in Prince George's County and Montgomery County. This

method was chosen in part due to time constraints. The huge area and number of blocks in each of these counties would have required significant time commitments if an alternate method was pursued. The method also works well for these two counties because my zoning data for these two counties consists of zoning districts aggregated to generalized zoning-density classes. Since this data was aggregated to cover larger areas, precision was less important for these counties.

Another potential assignment method would have been assigning Census blocks numerous zoning variables all weighted based on the percentage of the block's area that they occupy. This method represents an improvement upon the centroid method because it considers all the zoning districts within each Census block. Each Census block's population figures could then be distributed among the various zoning districts covering the Census block's area. This method, however, also has some significant problems. The major issue with this method stem from the inaccuracies inherent in Tiger/ Line shapefiles. Figure A.2 exemplifies this problem. The actual block locations portrayed by city street shapefiles do not correspond with the block locations represented by the Tiger/ Line shapefile. This poor spatial accuracy of Tiger/ Line shapefiles would lead to many inaccuracies in assigning zoning variables based on an area-weighted method. The GIS would weight zoning districts that fall within Census block boundaries represented by the Tiger/ Line shapefile but could not recognize the actual locations of Census blocks. For example, block 1 of Figure A.2 would be assigned RM zoning for about one-half of its area even though block 1 predominantly consists of RCX zoning. Block 4 actually consists entirely of RM zoning, but if this area-weighted method were used, the GIS would assign significant weights to RCX and CL zoning.

A third option, and the option I used for assigning zoning variables to Census blocks in Washington, D.C., Alexandria, and Frederick, was a manual zoning district assignment. This method was by far the most tedious method – I had to visually analyze each Census block and manually assign a zoning district to each block. Considering that Washington, D.C. alone has nearly 6,000 Census blocks, this process was quite lengthy. The process, however, results in the most accurate zoning district assignments. By manually assigning zoning districts, I was overcome the inaccuracies of the Tiger/ Line shapefiles. For example, in block 1 of Figure A.2, I saw that the RCX zoning district covered the majority of the block's actual area, and I was able to assign the RCX district to this block.



Data Source: Census TIGER/LINE; City of Alexandria

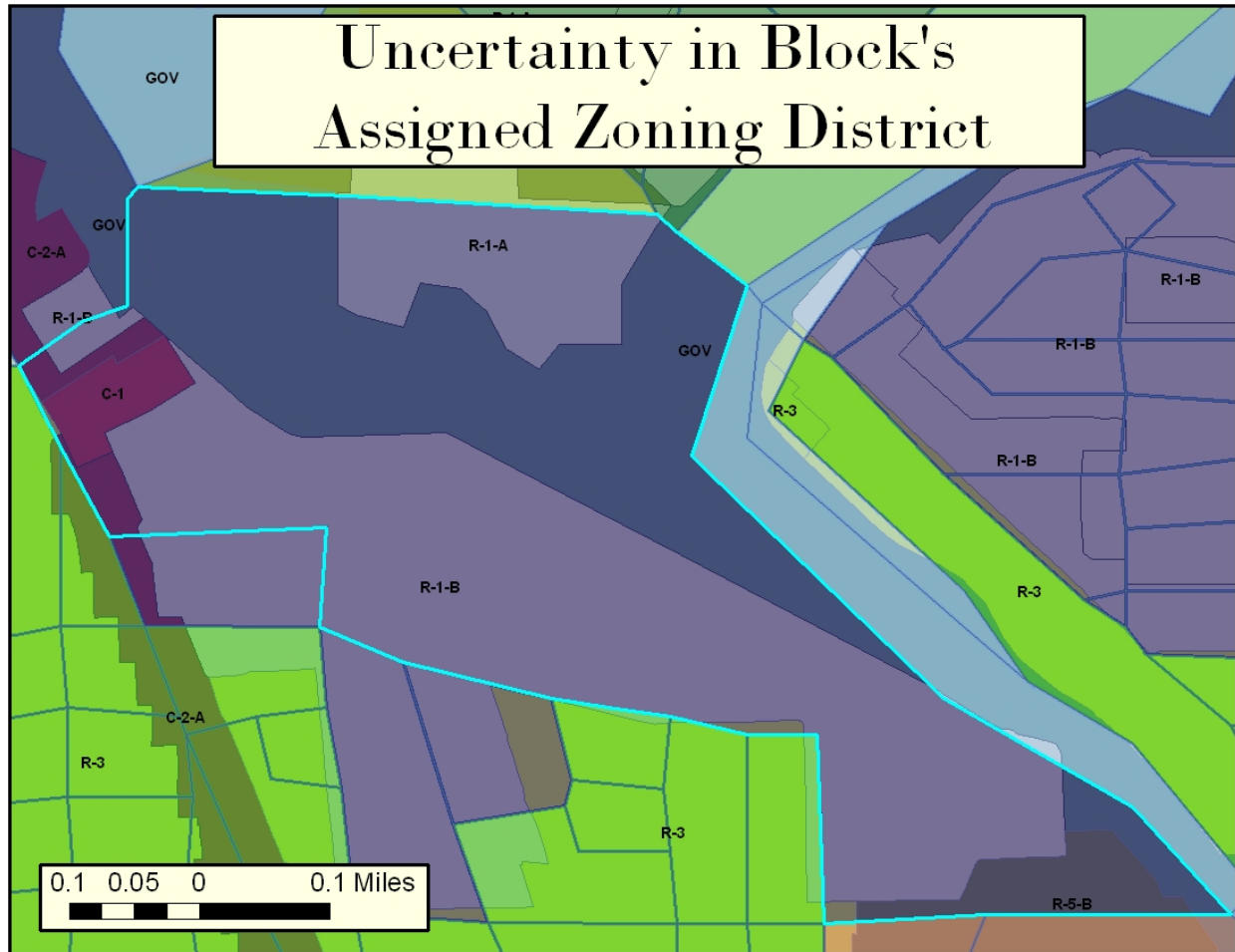
The manual assignment method also enabled me to establish the criteria needed to best capture the zoning district that contained the majority of the block's population. My criteria involved assigning each Census block the residential zoning district that occupied the largest area of each block. I gave preference to residential zoning districts because these districts typically have higher populations than commercial, industrial or other non-residential districts. If the block had more than one zoning district within its boundaries, I also assigned a second

zoning variable to that Census block. This second zoning variable was used in my uncertainty analysis to measure the amount of blocks that had some confusion as to the zoning district in which their population resides.

No matter which method I applied, uncertainty is inherent in this study because the smallest unit of Census geography does not always align with only one zoning district. Knowing how the population is distributed within Census blocks would have aided in clarifying this uncertainty. Wu (2006) discusses methodology to use a city's building shapefile to obtain highly accurate sub-block population estimates. By using this method, I could have known how the population was distributed within a Census block. This would have clarified Census blocks that cover more than one zoning district because I would know how much population resides in each zoning district. Using this information, I could have assigned each Census block the zoning district that contains the majority of its population or I could have assigned each block multiple zoning districts based on the percent of the population contained within each district. Washington, D.C. was the only locality for which I was able to obtain a building shapefile, and this shapefile does not contain the necessary attributes to conduct this analysis.

As a result, this study contains some uncertainty among those Census blocks that contain more than one zoning district within its boundaries. Figure A.3 shows an example of a Census block containing multiple zoning districts. I assigned R-1-B as this block's zoning variable because it is the residential district comprising the largest portion of the block's area. I have no way of knowing, however, whether the R-1-B district or one of the other districts within the block's boundaries contains the majority of the block's population. The uncertainty regarding Census block's zoning assignment in Washington, D.C. is analyzed in Chapter 4.

FIGURE A.3



Data Source: Census TIGER/LINE; City of Alexandria

SENSITIVITY ANALYSIS

GIS has become increasingly powerful, allowing greater levels of research to be conducted. This power that GIS provides us as researchers, however, must be applied with care. GIS still depends on data that can be prone to significant errors. Due to error-prone data and processes, uncertainty is an important element to consider in any GIS project (Blakemore, 1984; Poiker, 1982). The sensitivity analysis in this section will examine some of the shortcomings of my study due to data limitations. This sensitivity analysis will be important in determining the viability of further research of this type.

Although this project's results shed light on the connection between zoning districts and racial distribution, there is much uncertainty regarding the zoning district assigned to each Census block. The population within a block might not be entirely located within the block's

assigned zoning district. For example, a block assigned an R-1-B zoning district might actually have a majority of its population residing in an R-5-A zoning district. This block would have been assigned R-1-B because R-1-B is the largest residential zoning district in the block, but the majority of the block's population could be residing in the smaller R-5-A district. Since the Census block is the Census' smallest unit of analysis, I cannot distinguish population patterns within Census blocks and cannot avoid this type of error. There are numerous Census blocks that contain more than one zoning district, which leads to some degree of uncertainty. It is important to understand the level of error involved with this study in order to better know the level of accuracy of the results. This type of uncertainty is going to be an ongoing problem with any further research that is done to assess zoning's impact on racial and ethnic segregation within jurisdictions. Thus, uncertainty is important to address in order to assess the possibility for future research projects of this kind.

To analyze the uncertainty of a block's assigned zoning district, I will conduct various analyses. The first analysis involves comparing the actual area of each zoning district to the area of all the blocks assigned that

zoning district. Table 4.10 shows the results of this area comparison.

The overall error margin of 23% indicates that the zoning districts assigned to blocks do not precisely correlate with the actual zoning districts. This high figure, however, does not mean that 23% of the population is improperly classified. Much of the error involved in this area analysis comes from the system of overassigning residential zoning

and underassigning government, commercial, and other zoning districts. If a commercial and a residential zoning district both occupy part of the same block, the block will be assigned to the residential zoning district. This selection process is due to the fact that most of the population

TABLE A.1 – Uncertainty by Block Area

Zoning	Area in Acres			Error Margin
	Actual	Assigned	Difference	
R-1-A	1866	2583	(717)	38%
R-1-B	6119	6924	(805)	13%
R-2	2855	3034	(180)	6%
R-3	1629	1791	(162)	10%
R-4	3508	4171	(663)	19%
R-5-A	4396	5867	(1471)	33%
R-5-B	1349	1787	(438)	32%
R-5-C	38	37	1	2%
R-5-D	678	861	(183)	27%
R-5-E	103	148	(45)	44%
GOV	11152	8475	2677	24%
COMM	3050	1660	1389	46%
OTHER	7108	6396	712	10%
AVERAGE			726	23%

Data Source: Census 2000; City of Washington

resides within residential zoning districts, not commercial or other zoning districts. Thus, a much lower area of blocks will be assigned as commercial, government or other zoning districts than the actual area of these zoning districts. Also, this analysis shows that all residential zones other than R-5-C are assigned a larger area than is actually zoned. Thus, part of the error shown by this analysis will not lead to error in the demographic analysis of zoning districts.

I created a contingency matrix to further analyze the uncertainty inherent in my analysis. Points were randomly chosen throughout Washington D.C. to verify if these locations were actually in the zoning district to which they were assigned or if they were located in a different zoning district. The contingency matrix shown in table A.2 shows the level of uncertainty among residential zoning districts and Census blocks. The overall accuracy of these random points in residential zones is 83%. This is a fairly high level of accuracy, but it still shows that around 17% of areas in the City of Washington, D.C. were assigned the wrong zoning district because of numerous zoning districts within Census blocks.

TABLE A.2 – Contingency Matrix; Residential Districts

Actual Zoning													User Accuracy
	R-1-A	R-1-B	R-2	R-3	R-4	R-5-A	R-5-B	R-5-C	R-5-D	R-5-E	SUM		
Assigned Zoning	R-1-A	19	1	1							21	90%	
	R-1-B		18	1	1		3				23	78%	
	R-2			19		1	2				22	86%	
	R-3				15	1	1		2		19	79%	
	R-4				1	25	3	2		1	32	78%	
	R-5-A		1	2			28	4		2	37	76%	
	R-5-B							20		2	1	23	87%
	R-5-C								7			7	100%
	R-5-D		1			1				15	1	18	83%
	R-5-E										10	10	100%
SUM	19	21	23	17	27	29	33	9	21	13	212		
Producer Accuracy	100%	86%	83%	88%	93%	97%	61%	78%	71%	77%		83.0%	

Data Source: Census 2000; City of Washington

Another uncertainty analysis involves determining the number and proportion of Census blocks that occupy more than one zoning district. Blocks that only occupy one zoning district

have no chance for error regarding the zoning to which this block was assigned. A great deal of uncertainty exists, however, for those blocks that cover two or more zoning districts. These blocks may be assigned to the zoning district that encompasses the majority of the block's population. Conversely, the block may be assigned to one district but have a majority of its population in another district.

Table A.3 displays the number, percent, area, population and minority population of blocks containing two or more zoning districts. Nearly one-quarter of all Census blocks in Washington D.C. occupy more than one zoning district. Even more alarming, 42% of the population resides in a Census block that occupies more than one zoning district. This 42% of the population is suspect to some degree of uncertainty in my studies.

TABLE A.3 – Blocks by Level of Uncertainty

	Blocks		Area (Acres)		Population		Minority Population	
	Total	Percent	Total	Percent	Total	Percent	Total	Percent
All Blocks	5674	100%	43735	100%	572059	100%	343312	100%
One Zone within Block	4314	76%	31703	72%	329923	58%	208855	61%
Two or More Zones within Block	1360	24%	12032	28%	242136	42%	134457	39%
2nd Zone is not Residential	872	15%	6703	15%	118055	21%	69907	20%
2nd Zone is Residential	488	9%	5329	12%	124081	22%	64550	19%
2nd Residential Zone is Higher Density	246	4%	2663	6%	60725	11%	23607	7%

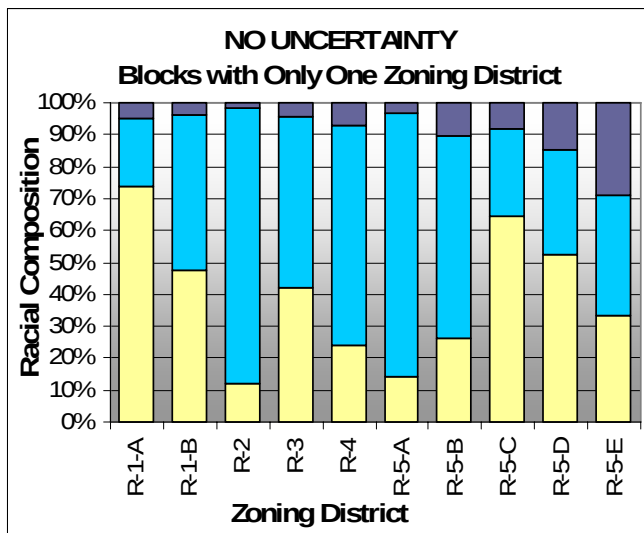
Data Source: Census 2000; City of Washington

Many of these blocks, however, contain only one residential zoning district. Blocks that contain one residential zoning district and one commercial or other non-residential zoning district will have much less uncertainty than blocks with more than one residential district. While only 9% of blocks contain two or more residential zoning districts, 22% of the population resides in these blocks. This population represents a high degree of uncertainty. 11% of the population resides in a block that is classified as the highest-density residential zoning district within the block. This half of the population should have less error associated with it. If a zoning district allows more density and occupies more of a block's area, this zoning district should contain the majority of the block's population. These blocks still have a high degree of uncertainty because some unknown portion of the population within the block is residing in a different zoning district. The other 11% of the population resides in blocks that are not designated as the highest-density residential zoning within the block. This 11% of the

population represents the highest potential for error because it is likely that the majority of the block's population resides in the highest-density zoning and not the assigned zoning:

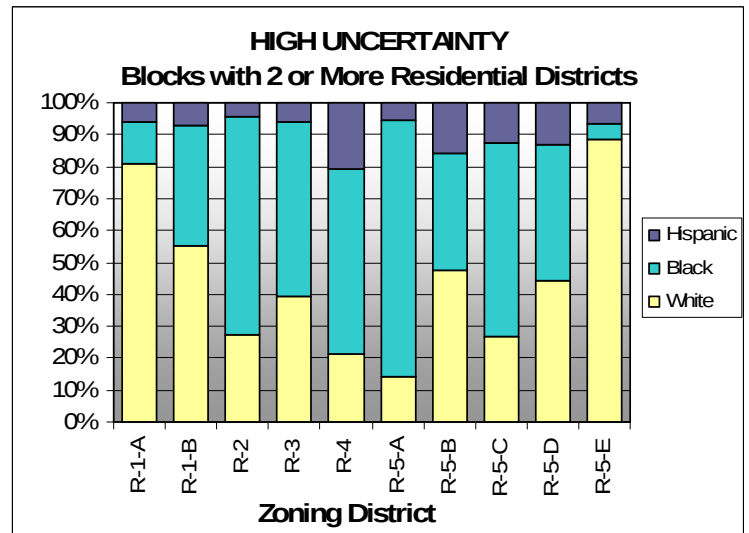
Although 42% of the population is subject to some uncertainty and 22% of the population is subject to a high degree of uncertainty, this population's impact on the study results are not yet clear. To clarify this issue, I created 2 charts that display the racial distribution among blocks with no uncertainty (Chart A.1) compared to the racial distribution of blocks with a high degree of uncertainty (Chart A.2). Chart A.3 enables a comparison with my original results. These charts show that the racial composition of many zoning districts is affected by these uncertain blocks.

CHART A.1

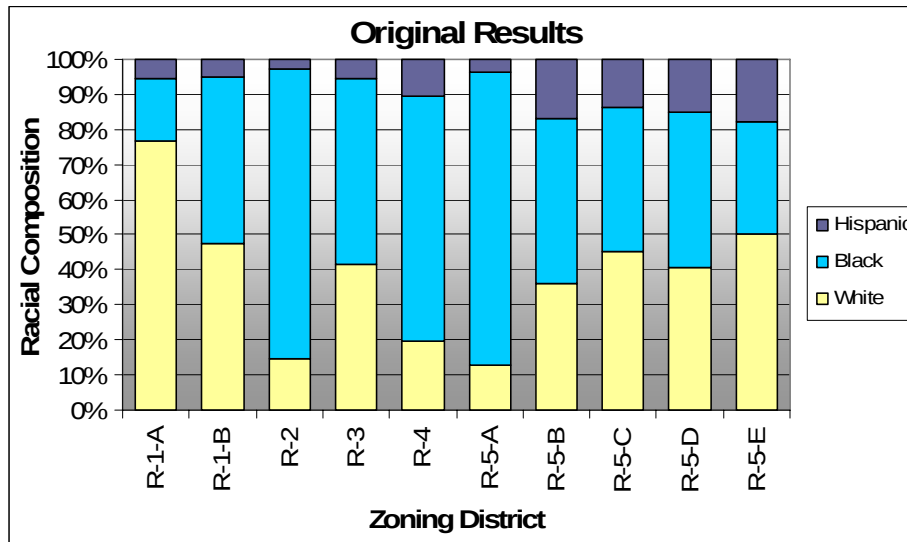


Data Source: Census 2000; City of Washington

CHART A.2



Data Source: Census 2000; City of Washington

CHART A.3

Data Source: Census 2000; City of Washington

Uncertain blocks assigned to R-5-B, R-5-C and R-5-E are significantly different than the blocks assigned with certainty to these districts. Uncertain blocks in the R-5-B district have a lower proportion of minority residents than the certain blocks in the R-5-B district. My results for the R-5-B district could be skewed by these uncertain blocks, and the actual population in the district could contain a higher minority population than originally indicated by my study. My results for the R-5-C district could be skewed in the opposite direction because uncertain blocks in this district have a much higher proportion of minorities than the certain blocks within this district. The actual R-5-C district could contain a higher white population than my study indicates. The relatively low proportion of minority (both Hispanic and black) residents in the uncertain blocks for the R-5-E district indicates that the actual population in the R-5-E district could contain a much higher proportion of minority residents than claimed by my study.

The uncertainty of these three multi-family zoning districts could be leading to the illusion that a high proportion of whites reside in these districts. R-5-B and R-5-E zoning districts have a much higher minority population when uncertain blocks are removed. The combined total population of these districts is over 83,000, while the population of the R-5-C district is less than 3,000. Although the R-5-C district could contain less minorities than originally estimated, this district's minimal population will have little effects on the overall results. The impact from potential error in the R-5-B and R-5-E districts is much greater.

Consequently, results adjusted for uncertainty would show higher minority populations residing in multi-family zoning districts.

These sensitivity analyses indicate high levels of uncertainty regarding the results of this project. Uncertainty levels decline when only the relevant residential zoning districts are considered, but uncertainty remains a significant factor. Although only 12% of areas fall inside blocks containing multiple residential zoning districts, 22% of the population resides within these districts. This high portion of the population has some uncertainty associated with it. Although the majority of this population should reside in the zoning district assigned to the block, a good portion of this population most likely resides in a different zoning district. This improperly-classified population seriously affects my racial composition results for the R-5-B, R-5-C and R-5-E districts. Due to potential error in these districts, my results will show a higher proportion of minorities residing in multi-family zoning districts when adjusted for uncertainty.

VITA

Defense Date: March 29, 2007

Jason Crampton was born on September 22, 1981 in Show Low, Arizona. After finishing high school, Jason moved to Tucson to attend the University of Arizona. At the University of Arizona, Jason found an interest in geography, urban planning, economic development and the Latin American culture. He followed his interests as he obtained a bachelors of arts in Latin American studies and a bachelors of science in regional development with a minor in urban planning.

Upon graduation from the University of Arizona, Jason spent one year outside of the academic arena. Jason spent two months volunteering in Ecuador and two more months traveling around South America. When he returned to the United States, he took the Town Planner job with the Town of Pinetop-Lakeside, Arizona. This position provided him with valuable planning experience, but Jason left the job after six months so he could pursue graduate studies at Virginia Tech.

At Virginia Tech, Jason has studied urban and regional planning. His interests include land-use planning, social planning, affordable housing and GIS. While studying at Virginia Tech, Jason has been a graduate assistant. During his first year, he worked with a series of databases and conducted a number of statistical analyses on the data. During his second year, he was the teaching assistant for the Urban Affairs and Planning Department's quantitative analysis class. Jason also worked as the Special Projects Planner for the Town of Pinetop-Lakeside during school breaks.