Testing Social Disorganization Theory on Violent Crime:
A Case Study on Pueblo, Colorado

by

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A Thesis Presented to the
Faculty of the USC Graduate School
University of Southern California
In Partial Fulfillment of the
Requirements for the Degree
Master of Science
(Geographic Information Science and Technology)

August 2019

To my family, without their support and love this dream would not have been possible. And a special thanks to my loving girlfriend who stood by me through this journey.

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Acknowledgement

I would like to start by thanking Dr. Laura Loyola for pushing me to my limits and helping me every step of the way in finishing my thesis. Her continued support and guidance gave me the drive to cross the finish line. I would also like to thank the other members of my thesis committee Drs. Jennifer Bernstein and John Wilson for their support and help. Lastly, I would like to thank all of the other professors who helped me to better understand the world of GIS through my path of earning a Masters degree.

List of Abbreviations

BCS	British Crime Survey
CHPD	Columbia Heights Police Department
CSV	Comma Separated Value
EDGIS	(Pueblo County) Economic Development and Geographic Information System
GIS	Geographical Information Systems
IMS	Interactive Mapping System
KDE	Kernel Density Estimation
MAUP	Modifiable Areal Unit Problem
PPD	Pueblo Police Department
SES	Socioeconomic Status
SDT	Social Disorganization Theory
STAC	Spatial and Temporal Analysis of Crime
USDL-BLS	United States Department of Labor-Bureau of Labor Statistics

Abstract

According to social disorganization theory, crime is caused by social and economic variables at the neighborhood level. Coined in 1942 by Shaw and McKay, their research utilized the city of Chicago as a natural laboratory to examine how social and economic variables affected crime. It was decided to test this hypothesis using Pueblo, Colorado because of the high crime rate. To test if the theory of social disorganization applies to Pueblo, violent crime and socioeconomic status were analyzed spatially to answer the following questions: 1) have crime rates changed over time? 2) do the changes in crime rates have a spatial pattern? and 3) does the change in crime rates mirror housing values?

Data on violent crimes was determined with the assistance of the Pueblo Police Department, who provided the location of 4,500 individual violent crimes across the city from 2006 to 2016. Statistical analysis showed that many of the counts of individual crime types were too low to be statistically significant, so the five crimes with the highest occurrence were used for further analysis. Socioeconomic status was determined using the housing values within the City of Pueblo.

Hot spot analysis using the GI* statistic, which uses high and low z-scores to determine clusters of high values (hot spots) and clusters of low values (cold spots), was used to determine statistically significant high crime areas within Pueblo. These hot spots were used to determine where housing values would be analyzed. Statistical analysis showed that 2016 housing values sampled from within a hot spot area were lower than those samples from a non-hot spot area. Additionally, the average housing value in the sampled hot spot areas progressively decreased over the 10-year period, while those sampled in non-hot spots rebounded after the 2008 recession.

Chapter 1 Introduction

Crime in the City of Pueblo has been a major burden for its citizens for many years. Violent crime is especially concerning, as there has been a steady increase in violent crimes from 2006 to 2016 throughout the city (Colorado Department of Public Safety 2018). Violent crime, according to the Federal Bureau of Investigations Uniformed Crime Reporting Program, is defined as "offenses that involve force or threat of force." The relationship between crime and the economy is one that is interconnected; according to the United Nations Office on Drugs and Crime (2010), high violent crime rates affect economic levels, leading to a lack of investment which in turn puts pressure on trends of crime. Meaning that individuals or groups are less willing to economically invest in areas with high crime rates, additionally due to social disorganization of the community, it is unable to solve chronic issues, such as crime. Social disorganization theory attempts to explain this underlying pressure on crime based on economic factors, an example of this is the housing values of a high crime area. Social disorganization theory (SDT) adopted early use of geographical information systems (GIS) and the City of Chicago as a natural laboratory to study the effects of socioeconomic status on crime rates. By focusing specifically on violent crime (as defined by state and national standards) as a proxy for socioeconomic status in the City of Pueblo, this project will test social disorganization theory as a means to help explain why the city has witnessed an increase in these crimes. Specifically, this thesis aims to answer the following questions: 1) have crime rates changed over time? 2) do the changes in crime rates have a spatial pattern? and 3) does the change in crime rates mirror housing values?

1.1 A Brief History of Pueblo, Colorado

Pueblo, Colorado is located on the Interstate-25 corridor in Southern Colorado, 112 miles south from Denver, the state's capital. Located at 38°16′1″N 104°37′13″W the city of Pueblo has an area of 45.5 square miles (Figure 1). Pueblo sits at the foothills of the Rocky Mountains where the Great Plains stop, and the mountain range begins. The climate in Pueblo is mild, with annual precipitation averages around 12 inches. The winters see snow and the summers see highs in the low 100's with low humidity. While Pueblo, population ~111,000 and Colorado Springs are considered larger cities in Southern Colorado, spread across the area are even smaller cities. The confluence of I-25 and Highway 50 are the two major roadways, with I-25 traversing north to south and HWY 50 traversing the east to west.

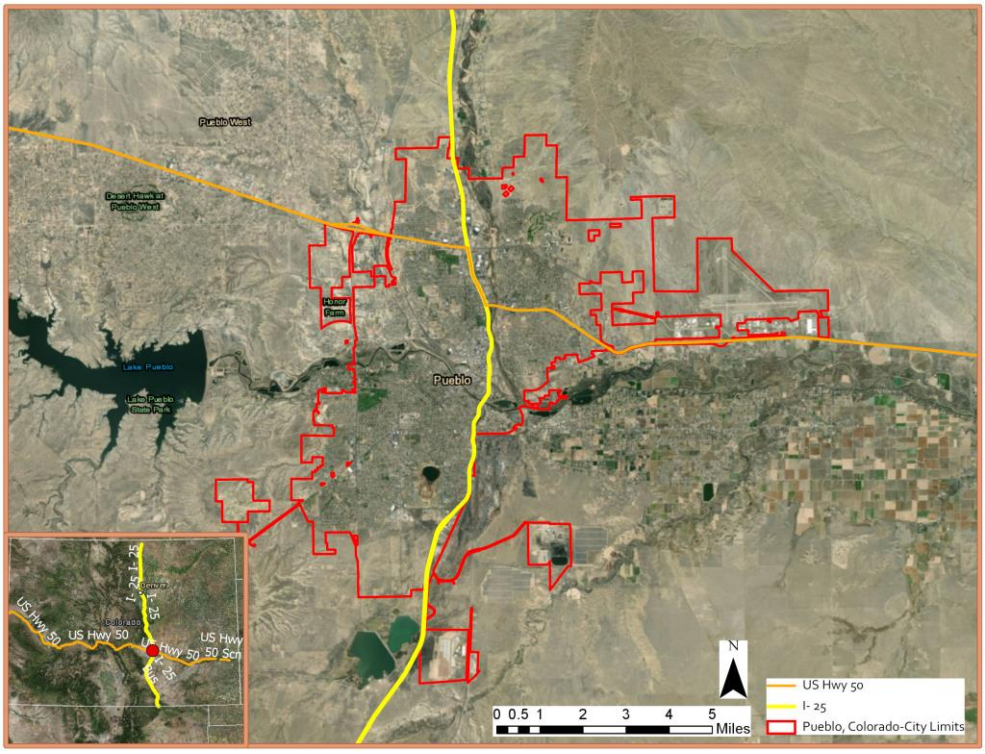

Figure 1-City Limits of Pueblo, Colorado

Pueblo was nicknamed the Steel City (Pittsburg of the West) in the late 19th century due to its roots as a large steel producer (Broadhead 2019) which was the main economic driver from the 1880's to the mid 1990's. The enterprise that was responsible for steel production in Pueblo was the Colorado Fuel and Iron Company (CF&I) (Broadhead 2019). CF&I's steel production facilities were the largest west of the Mississippi and was the largest employer in the State of Colorado, employing roughly 15,000 people at its peak (Rees 2017). The steel crash in the late 1970's hurt CF&I and the production in Pueblo, from which CF&I would never fully recover. The facility changed ownership several times during the 1990's and in 2006 was purchased by its current owner EVRAZ Corporation. EVRAZ currently produces steel rail, seamless pipe, rod, and coiled reinforcing bar (Ezez 2019).

Pueblo's current economic status within Colorado is below the state average, with a population of 109,122 (American Factfinder 2017) and an unemployment rate of 5.1% (United States Department of Labor-Bureau of Labor Statistics 2018), which is above the state average unemployment rate of only 2.9% (USDL-BLS 2018). This is one economic indicator that demonstrates Pueblo's economy is struggling. The median household income for Pueblo is $36,280, nearly half the state average (American Factfinder 2017). Additionally, housing values are low, with the estimated house or condo value of $126,200 in 2016 being less than half state average of $314,200 (American Factfinder 2017). This last socioeconomic status indicator of housing value is further examined in this thesis.

Furthermore, the large corporate employers for Pueblo tend to lack key economic drivers such as manufacturing and technology. The current high-end employers in the City of Pueblo include Vestas Towers America, Trane-Ingersoll Rand, United Technologies Corporation, Parkview Regional Medical Center, and DOSS Aviation (Hickenlooper 2018). These five-

businesses fall within one of four categories: 1) Health and Wellness, 2) Advanced Manufacturing, 3) Infrastructure Engineering, and 4) Transportation/Logistics. While these industries make up the higher end employment in Pueblo and many of the jobs require specialized training or education, these jobs are not abundant. Skilled verses unskilled labor is defined as skilled workers having specialized training or certification to complete a job, such as pipefitting, welding or computer programming; unskilled labor on the other hand does not require any type of specialized training or certification to be completed, such as a janitorial service, fast-food work, or sales. According to the United States Department of Labor-Bureau of Labor Statistics (USDL-BLS) estimates of employment per 1000 jobs, Industrial Production Managers account for 0.706 of the 1000, whereas Sales and Related Occupations comprise 114.349 jobs per 1000 (United States Department of Labor-Bureau of Labor Statistics 2018). This is not to say that the employers listed above employ more unskilled labor than skilled, it is a representation that employment as a whole in Pueblo contains much more unskilled laborers than skilled laborers. This is just one example of the discrepancy in high verses low skilled labor jobs in Pueblo, the entire list from the USDL-BLS is quite large and will not be included here. The lack of economic opportunity can be traced back to an uneducated workforce (Markus 2014). Education rates in Pueblo are below the state average as well, as of 2017 the high school graduation rate in Pueblo's School District 60 is 79%, of those graduating students 56.7% attend post-secondary schools (i.e. college or university) located in or out of the state. In total, only 19% of the population of Pueblo has attained any post-secondary education (American Factfinder 2017). The combination of below average education rates and low skilled workforce create an environment where the population of Pueblo is not resilient against economic fluctuations.

1.2 Crime in Pueblo

Given the size of Pueblo and the rather small police force (see Section 1.2.1), the City of Pueblo utilizes community policing, a technique that is:

> …a collaboration between the police and the community that identifies and solves community problems. With the police no longer the sole guardians of law and order, all members of the community become active allies in the effort to enhance the safety and quality of neighborhoods. (Bureau of Justice Assistance 1994)

This technique, which has its roots in the early days of the city police in London, England (Bureau of Justice Assistance 1994), has been used to address auto theft and other problems throughout the City of Pueblo. It has been a common way for police departments to interact with communities since its inception to build trust and a sense of ownership for safety in a community. However, the efficacy of this technique relies on the ability for a community to be involved, which can be influenced by multiple social factors, as discussed below, and economic factors, as previously mentioned.

Based on the ideal that both the police and the public act as law enforcement, community policing connects the police force back to the people and local stakeholders in the community. This type of policing was used on and off for many years but, was displaced by the advent of the automobile and radio systems in the early 1900's (Bureau of Justice Assistance 1994). These technological advances moved police officers off the streets and foot patrols and placed them in vehicles and offices, which removed them from the community; thus, creating a divide from Sir Peel's original idea of what the police stood for. Another argument that researchers have made for the disconnect between police and the community occurred from the reform of policies in the early 1900's that moved individual police officers to different areas of the city to avoid corruption. This corruption stemmed from the close relationship that the police and policy

makers shared. Because these politicians had control of the police and their departments, they were thus able to influence policy within the police in favor of the political elite (Walker 1999).

During the 1970's the Rand Corporation looked at the role of detectives and found that they only solved a small number of crimes without the assistance of the officers that were on patrol in the community (Bureau of Justice Assistance 1994). This once again changed the perspective and role of patrol officers within many police departments. Subsequently, officers received more training on solving crimes and working within the community (Bureau of Justice Assistance 1994), a move back to community policing. Several experimental programs were created in cities such as Newark, New Jersey and Flint, Michigan that put officers back on foot patrols in different neighborhoods. It was concluded that these foot patrols created a better relationship between the police and the community and at the same time giving the population a feeling of safer streets and less fear of crime (Bureau of Justice Assistance 1994).

Community policing has had success in many areas, one such area is the Columbia Heights Police Department, located in Columbia Heights, Minnesota. A case study of the CHPD found that although the police force lacked the ethnic diversity present in the community there was a decrease in crime (DeMeester, LaMagdeleine, and Norton 2011). The authors claim that this drop-in crime and high satisfaction of the police force by the population, was directly related to community policing techniques that were applied, they note:

> …the change from controlling crime through arrests, enforcement contacts and threats of consequences to focusing on connections and relationship building contacts has helped the officers know and understand the community they serve in new ways. Rather than reacting to crime, true crime prevention has begun in the community. (DeMeester, LaMagdeleine, and Norton 2011)

Although similar techniques have been implemented in Pueblo, it is difficult to determine if this technique is working or not. Within the annual reports provided by the Pueblo Police Department

(PPD) there was a discussion about programs that have been implemented to connect the patrol officers to the community, public, and stakeholders; however, there is little data to show that these efforts have been successful, nor is there data on the possible barriers to successful implementation of community policing. One possibility, further examined in this thesis, is that SDT is at play in Pueblo, inhibiting community organization and involvement in policing efforts.

Crime, in general, in the City of Pueblo is higher than the state and national averages. The instances of violent crimes in the United States and Colorado during 2016 were 397.5 and 338.1 per 100,000 people (Colorado Department of Public Safety 2018). For the City of Pueblo during that same time the instance of violent crimes was 688.7 per 100,000 people (Colorado Department of Public Safety 2018), much higher than either the national or states averages, which is troubling for both the residents and police force. This brings into question when and why the rate of crime has increased so dramatically, as well as the policing methods used throughout the city from 2006 to 2016. The following section discusses the current spatial allocation of policing resources in Pueblo.

1.2.1 Police Quadrants and Staffing

In addition to the PPD using community policing techniques, the city has been divided into four different quadrants, varying in size from 11.24 mi^2 to 20.70 mi^2, that are each patrolled by 3 or 4 officers during a shift, comprising a total of seven officers for the north and south parts of Pueblo (Figure 2). In short, Corporal David Jacober of the PPD (pers. comm. 2018) explains the quadrants and staffing as two "crews" a Blue and a Green, each of which is staffed with 14 officers. The two crews alternate time on and off and both cover the same quadrants when the other is not on duty. Of note are the temporal assignments of the crews by quad with the day shift on duty from 0730 to 1730, afternoons 1200 to 2200, and overnight from 2200 to 0800 (Table 1).

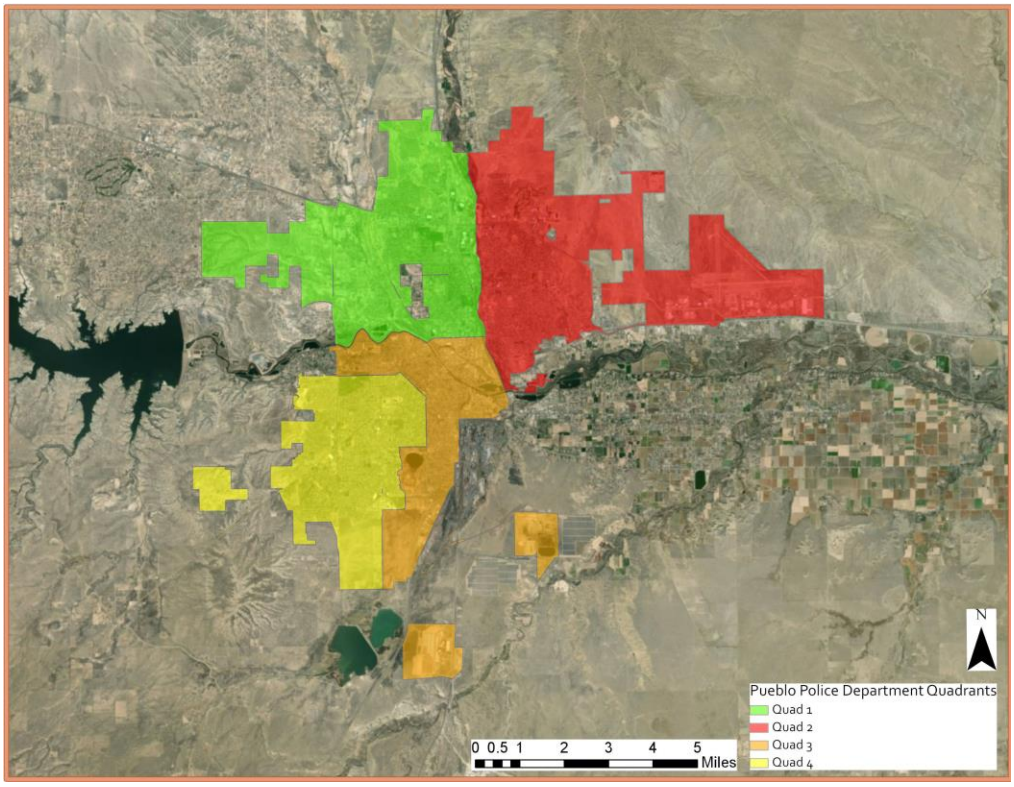

Figure 2-Pueblo Police Department Quadrants

Table 1. Police Staffing for Pueblo, Colorado

Blue Crew	Green Crew
14 Officers	14 Officers
North - Quads 1 and 2	North - Quads 1 and 2
South - Quads 3 and 4	South - Quads 3 and 4
Quad 1 (16.94 mi^2): 4 Officers Quad 2 (20.70 mi^2): 3 Officers Quad 3 (11.24 mi^2): 4 Officers Quad 4 (11.67 mi^2): 3 Officers	Quad 1: 4 Officers Quad 2: 3 Officers Quad 3: 4 Officers Quad 4: 3 Officers

Corporal Jacober explained that the assignment of patrol officers to quadrants is roughly based on the number of calls for service the PPD receives. He also mentioned that even though they may have assigned officers to a certain quad, it was not uncommon for officers to respond to a call in another quad to provide backup or assistance. The first part of this thesis examines the overall spatial pattern of violent crime in Pueblo, as well as the spatial distribution of these crimes in with respect to police quadrants (Chapters 3 and 4).

1.3 Social Disorganization Theory

The theory of social disorganization is a criminology term that has evolved since its creation from the Chicago School in the early 1920's, where crime theory switched from looking at genetic patterns of criminals to societal factors affecting crime (Williams and McShane 2004). Social disorganization theory's (SDT) roots are founded in urban research conducted by Robert Park and Ernest Burgess on urban concentric ring theory, which shows how the ideal city or town should be built. This model is discussed further in Section 2.1.2, but briefly it is described as rings moving outward from the city center, which is considered the business district, and is followed by the transition zone or commercial zone. Next is the workingman's homes zone, followed by the residential zone or the upper-class area, and lastly the commuters' zone or the suburbs (Park and Burgess 1925). SDT grew out of the concentric theory by looking at each ring and determining that the inner most ring would have more crime than the outer rings because the inner rings contain the less desirable aspects of society, less desirable housing and more commercial business, while pressure is placed on the outer rings and crime inevitably follows the expansion and invades the outer rings. When this crime moves into residential areas in the outer rings the population moves out as quickly as possible, creating an environment where reconstruction or community betterment is not possible (Shaw and McKay 1969). Thus, creating a residential area that has low economic value and high crime. The Shaw-McKay model of social disorganization has been a standard in criminology studies for many years, however this theory was not tested until the late 1980's. This research tested the hypothesis that an increase in crime rates is due to a variety of factors, such as economic status, ethnic makeup of the area, and family disruption. They predicted that each of these social factors negatively influence crime through the lack of the community to accomplish common goals (Sampson and Groves 1988).

SDT, the findings of Sampson and Groves, and later works will be discussed further in detail in Chapter 2. This thesis examines the rate of crime in Pueblo, CO and socioeconomic variables through the lens of social disorganization theory to answer the stated research questions and to provide additional information to the PPD in terms of efficacy of community policing.

1.4 Research Question

According to Sampson and Groves (1988) as well as Shaw and McKay (1969), socioeconomic status (SES) has been an ecological correlate of crime in some urban areas. This thesis examines the correlation between SES and crime rates, using housing value as an indicator of SES (see Section 2.3). This project aims to answer three questions: have crime rates changed in Pueblo from 2006-2016, do these crimes have a spatial pattern, and does the change in crime rate reflect the change in housing values in Pueblo, Colorado? This will be accomplished by a temporal analysis of crime from 2006-2016, then by examining the spatial distribution of crime in Pueblo, and finally by a spatial analysis of the SES indicator. Given the small geographic area of Pueblo, small areas of both crime and home values are examined at the scale of the city block.

1.5 Thesis Structure

The remainder of this thesis has four chapters. Chapter two covers SDT crime theory as well as a literature review covering the analysis techniques used for determining spatial patterns of crime. Chapter three includes the data sets utilized as well as the spatial visualization and analysis techniques used. Chapter four presents the results of the analyses. Chapter five addresses the limitations to this study, the conclusion, and suggestions for future research and analysis.

Chapter 2 Literature Review and Crime Theory

This chapter reviews the literature that builds the foundation for the theoretical background and methodological choices made for this geospatial crime analysis. The literature examines previous studies to determine what quantitative spatial analyses were used, how these types of analyses have been applied to crime mapping, and case studies that have applied these analyses to violent and non-violent crime. Background is also provided on how the housing variable was selected to represent economic status and how high crime and low economic opportunity are related.

2.1 Criminology Theories

In the study of criminology there are many theories as to why crime happens. While determining the spatial distribution of crime is a key element of this thesis, the potential to further examine crime within a theoretical framework is also relevant. Therefore, I present here a brief summary, and by no means a comprehensive list of all the criminology theories and literature, before expounding on SDT.

The aim of criminology theory is to examine a variety of factors in an attempt to explain why people commit crimes. Some theories focus more on the individual, while others focus on external and societal forces. The following summaries of each theory are all based on definitions provided by the National Criminal Justice Reference Service (2019) and the work of Frank P. Williams and Marilyn D. McShane (2004).

In the first group of theories that focus on the individual are: rational choice theory, life course theory, and routine activity theory; while social disorganization theory, conflict theory, labeling theory, and social control theory are in the second group. Rational choice theory says that people will act in their own best interests and commit crimes after looking at the risk versus the reward. This theory was introduced in the late 18th century (Williams and McShane 2004)

and has since been intermixed with many other criminology theories listed. Life course theory examines one's life and early life events, and how said events affect the outcome of that person's choices to commit crime. In the 1920's, theorist Karl Mannheim thought that one's experiences as a child would build the foundation for adulthood, and that these experiences passed from parent to child over many generations (1935). Mannheim's original life course theory was not focused on crime, and as time progressed other theorists built on his theory and applied their findings to criminology. It was found that a lack of parental oversight as a child and one-parent households led to higher instances of not only child offenders but adult offenders as well (Williams and McShane 2004). A theory that removes the developmental aspect, still focuses on the individual but includes an aspect of external forces, is the routine activity theory.

There are three aspects of this theory. First, is a person who is willing and motivated to commit crime, second is a target, and third is the absence of some type of deterrent such as a police officer or other form of active or passive category of security measures. This theory has been tested for many years and it has been found that if an individual has been exposed to crime they are more likely to commit crime (Williams and McShane 2004).

Criminology theories that focus more on external factors include conflict theory, which pits one social class against another and states that laws are created to protect those in power, thus creating further conflict between the two groups of society. This theory has roots in sociological work performed in the 1950's from Lewis Coser, who did not agree with the current and past theories of the nature of societies (Coser 1957). Much like Marxist Social theory, conflict theory claims that those in power create laws to protect themselves and their way of life. This theory is not popular, mainly because it assumes that the wealthy have created a biased

justice system (Williams and McShane 2004). In contrast, labeling theory looks to the process of labeling individuals.

Labeling theory states that once a person has been labeled by society as a criminal or delinquent, they inevitably become that label. This theory was heavily used from the early 1960's to the 1980's and was considered to be a product of societal changes that happened during that time. Labeling theory focuses on society's labeling of young offenders, and these labels following the individual for the remainder of their life, turning them from a juvenile offender to a repeat adult offender (Williams and McShane 2004). Another theory that focuses on societal responsibility is social control theory, which places the responsibility of crime in the hands of society through maintaining law and order. This theory relies on clear concise guidelines to halt crime and that without them, crime will occur because people are born to be delinquents (Hirschi 1969). This theory is the closest relation to SDT in the fact that it looks to society, rather than the individual to explain why crime is committed. However, SDT includes an important factor of the community's ability to organize, as determined by socio-economic factors. Social disorganization theory is the best to test in this thesis, as it has its roots in GIS and uses socioeconomic factors to explain why crime happens. The following subsections will discuss this theory in detail.

2.1.1 The Chicago School and Concentric Ring Theory

Concentric Ring and SDT used the City of Chicago as a natural laboratory for testing and used the population as test subjects through observation only, there was little to no manipulation of the people or economy. The Chicago School scholars used both individual case studies as well as population statistics to build the sociological and criminological theories that are still used

today. They believed that “human behavior is developed and changed by the social and physical environment of the person rather than by genetic structure” (Williams and McShane 2004, 46).

Social disorganization theory started with Robert Park and Ernest Burgess’s idea that human ecology was much like that of plant and animals, sharing a symbiotic interdependence with one another through the time and space that they naturally exist in (Williams and McShane 2004). Park and Burgess first began with the Concentric Zone Theory (Figure 3), which was briefly explained in the introduction section of this text. This breaks a city down into zones which represent different areas of socioeconomic status as related to crime occurrence. Concentric zone theory explains the inner zones have a propensity to grow larger in population, and eventually said population moves to the outer zones (Park and Burgess 1925). Thus, taking the woes of the inner zones outward to the next zone. This relates to social organization and disorganization to explain that the relationship between the two is reciprocal and “so far as disorganization points to reorganization and makes for more efficient adjustment, disorganization must be conceived not as pathological, but as normal” (Park and Burgess 1925, 54). To better understand this theory, it is necessary to look at each individual zone and the ecology of the population per zone.

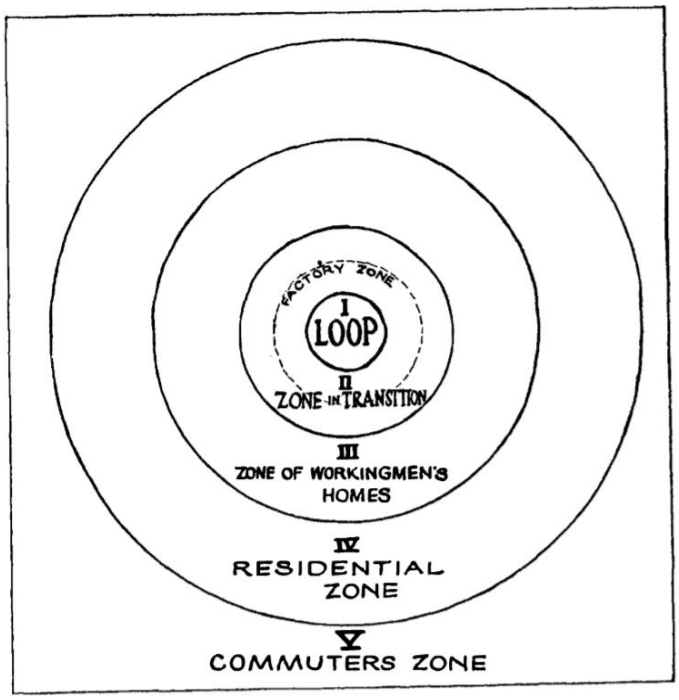

Figure 3-Concentric Zone Example from "The City" by Park and Burgess (1925)

The first zone that is to be examined is Zone I or "The Loop," within this zone we would find the central business district from which the city is expanding. According to Park and Burgess this area is where the larger homeless population exists (Park and Burgess 1925). Zone II or "Zone in Transition", encompasses the downtown area and is an area to where business and light manufacturing are migrating (Park and Burgess 1925). Park and Burgess note that Zone II is in a state of decay and this is where we will find large populations of poor, and one might find rundown neighborhoods that see high crime rates and decay. This area is also where Park and Burgess claim that we would find newly immigrated families and colonies. Zone III or "Zone of Workingmen's Homes" is where the working class would be found and those who have "escaped the area of deterioration" of Zone II, but still want to live close to their places of employment. Zone III sees a mix of old and new development and contains a large amount of rental properties; in addition, this zone is where second-generation immigration families would live. The second to

last area is Zone IV, or the "Residential Zone," this is where one would find "high-class apartment buildings or of exclusive 'restricted' districts of single-family dwellings" (Park and Burgess 1925, 50). And the last area of the city is Zone V or the "Commuters Zone" and is considered the suburbs. Park and Burgess state that this area is within a half hour or hour drive to the city center (Zone I) and is where the populations from the inner zones would like to live. These zones comprise the makeup of the "urban" area of an American city, according to Park and Burgess.

This makeup of the American city is where one starts to understand how SDT became such an important criminological theory. Cities are an ever-evolving ecosystem, and within this ecosystem groups of similar individuals are formed. In a city, these groups tend to be of the same economic status or cultural background and are what give a city personality. This process of separating out groups, gives not only the group but also the individual a position and function within the coalition of the city construct (Park and Burgess 1925). Burgess and Park constructed the foundation that SDT was built on. In the following section, the evolution from Concentric Zone Theory to SDT and beyond is explained in more detail.

2.1.2 Evolution of Social Disorganization Theory

From Park and Burgess in "The City" (1925), we move to a set of theories completed by Clifford R. Shaw and Henry D. McKay titled "Juvenile Delinquency and Urban Areas." Within this text the authors take the Concentric Zone Theory and apply it to the City of Chicago. Shaw and McKay speak to the ever-evolving city in such a way as to explain the migration of people from the inner city to the outer rings. This migration creates a situation where the residential areas near the business and industrial areas are far less appealing than those of the zones that are further out (Shaw and McKay 1942). This pattern of migration is also central to SDT, in that as

the population moves from the inner zones the issues that made the inner zones less desirable for occupation eventually follow the migration, thus the migration will continually be evolving. They claim, that as a city grows there are seven parameters that are evidences of differentiation resulting from city growth (Shaw and McKay 1942). These 7 evidences are: demolition of substandard housing, increase and decrease of population, segregation of population on an economic basis, families on relief, median rentals (median rental and home value from the 1930 United States Census), occupation groups (types of jobs the population work), and economic segregation. Each of these variables were determined for use by the authors to indicate city growth and characterize areas of the city through their population density (total number of population and demographics including race and economic status) and allowed for measuring different rates of delinquency in the different areas. Shaw and McKay created maps (Figures 4 and 5) to display these variables through an early Geographical Information System (GIS). These maps both use a square mile grid system as the unit of analysis for the city, based on main streets as well as previous government surveys of Chicago, these grid cells represent SES variables. These maps also display the "Concentric Zones" through first increasing rental prices as one moves further from the central business district (Figure 4), as well as the decreasing number of families on relief (Figure 5). Through this early adoption of GIS, the authors were able to better understand the social construct of the city.

Shaw and McKay conclude that although social dynamics may be at play, there are many reasons for juvenile delinquency in the City of Chicago. These conclusions state that delinquency rates vary between both the inner zones and the outer zones, yet geographic location does not solely determine delinquency rates. Increased delinquency is also related to lack of institutions such as schools and social group settings, and rapid changes in populations, while ethnic and

racial factors are not characteristic of delinquency rates and do not show a direct causation to higher crime. Delinquency rates are correlated with socioeconomic status, and lastly some communities have higher and consistent delinquency rates because of the lack of community groups. This research on city structure propelled SDT, which was then built on by other scholars, specifically Robert J. Sampson and W. Byron Groves.

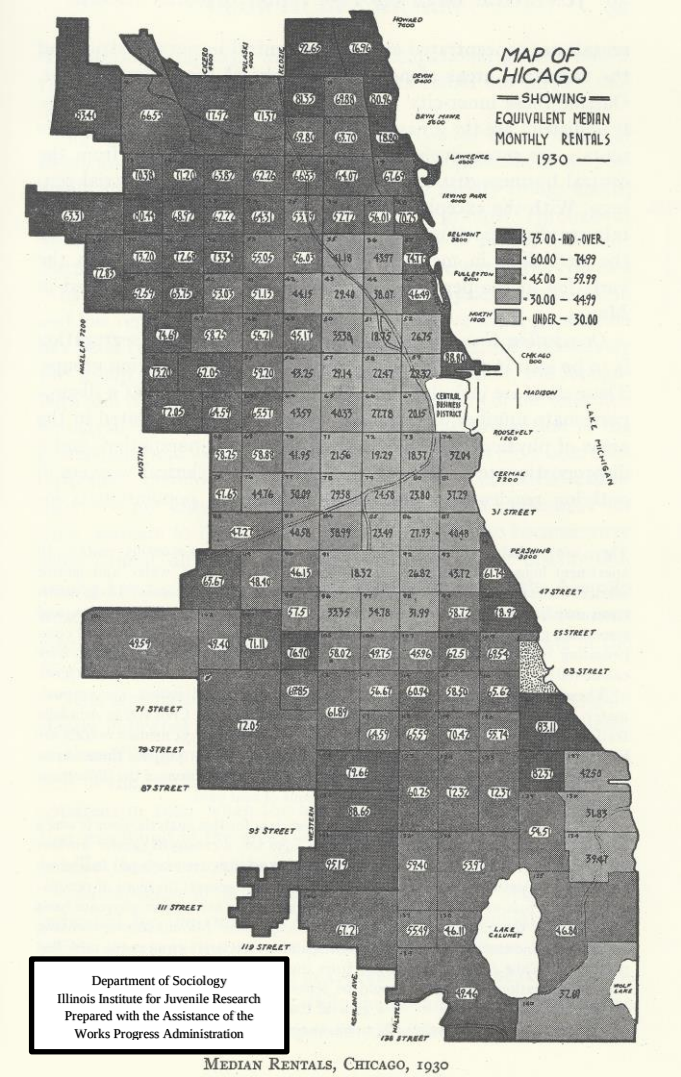

Figure 4-Map of Chicago, IL Showing the Median Rental Prices of Housing (Shaw and McKay 1942, 35)

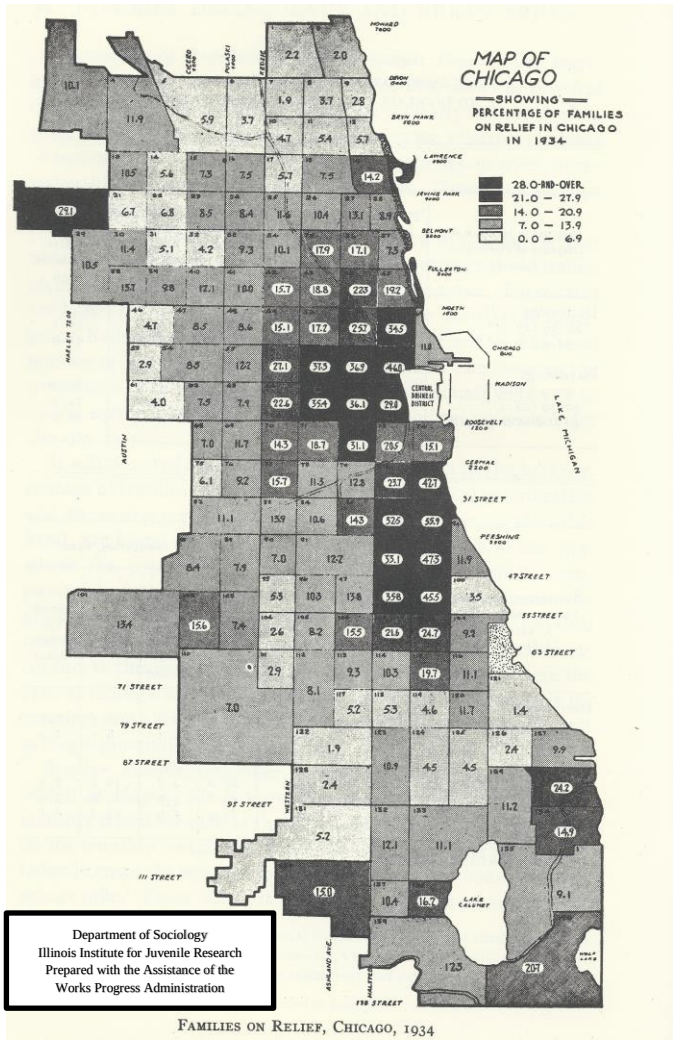

Figure 5-Map of Chicago, IL Showing the Percentage of Families Using Government Assistance (Shaw and McKay 1942, 34)

Sampson and Groves (1989) claim that the lack of individual/community level data and relying only on census data is the weak link in previous studies. In the years between the research by Shaw and McKay and Sampson and Groves (1942-1989) there were many scholars (Sutherland 1947; Suttles 1968; and Kornhauser 1978) that attempted to better refine SDT yet continued to use the same type of census data as Shaw and McKay. Sampson and Groves' goal was to go after the two limiting factors in past research: limited data and lack of direct testing. These were addressed through use of a large national survey of British citizens', the inaugural

British Crime Survey (BCS). The BCS consisted of a national survey of Wales and England during 1982 that looked at crime through a "macro-level community analysis" and sampled sixty addresses from each of the 238 communities within England and Wales and had an 80% response rate. The final survey included 13,702 households of randomly selected persons above the age of 16.

To test the theory of social disorganization, the authors created a model that included measures of three areas of social organization. These three areas are socioeconomic status (SES), residential stability, and ethnic heterogeneity. SES was measured by designing a "scale" from summarized z-scores of the statistics containing the major dimensions of social class, education, occupation, and income. In this "scale" education was defined by the percent of those who are college educated, occupation was defined by the percent of people in professional and management positions, and income was defined by the those with high incomes (amount not mentioned). Residential stability referred to "the percentage of residents brought up in the area within a 15-minute walk from home" (Sampson and Groves 1989, 785). To find the heterogeneity range of each group an index ($1-\Sigma pi^2$) was used where *pi* was a fraction of the population of a given group. Ethnic heterogeneity included five categories within the BCS: White, West Indian or African Black, Pakistani or Bangladeshi Indian, other non-white, and mixed, these population groups do not match the populations used in the United States Census because they are from a sample of British citizens (Sampson and Groves 1989). Both the use of the better data and the three indicators allowed for Sampson and Groves to better define social disorganization. According to Sampson and Groves, social disorganization "speaks not only to the ability of a community to achieve common values (e.g., to defend itself against predatory victimization), but also to community processes that produce offenders" (1989, 786). This

research took previous work further by examining data that was self-reported and focused on violent acts, allowing for a more micro-level analysis of violence in a community, and not merely juvenile delinquency.

Sampson and Groves concluded that SDT continues to play a role in crime analysis through the interpretation of micro-level crime rates, and that it can be applied to not only England and the United States but other nations as well (Sampson and Groves 1989). Sampson and Groves' findings provide evidence that communities showing low organizational participation, which is the participation of a population in activities in which they are not obligated to be active in such as a book club or church group, had much higher crime rates than those with a high percent of participation within the community. It was also concluded that differences in participation rates in the community had a central effect on community structural characteristics (low SES, residential mobility, ethnic heterogeneity, and family disruption) meaning that there is a strong negative correlation to community involvement, the structures that bind the community, and high rates of crime (Sampson and Groves 1989). The authors also note that their study was not without limitations as well as not a "definitive test of Social Disorganization Theory" (Sampson and Groves 1989, 799). Some of these limitations include small data sets in some of the areas of community organization and organizational participation rates were not precise in measure. Regardless of these limitations this study was a better test of Shaw and McKay's original research.

The work by Sampson and Groves was completed in the late 1980's, therefore to better understand the application of SDT in the present it is necessary to focus on more current works that examine SDT. Kubrin and Weitzer (2003) take the previous works on SDT and add several new approaches to examining it. First the shortcomings of previous works are addressed, these

deficiencies arise in the variables that have been decided upon for examination. The authors note "among the substantive issues addressed are the explanatory power of certain variables hypothesized to mediate the relationship between exogenous structural conditions and neighborhood crime (i.e., informal control, social ties, social capital, and collective efficacy)" (2003, 375). They address these issues by looking at variables that had not previously been used. These variables are: neighborhood culture, formal social control, and the urban political economy (Kubrin and Weitzer 2003). The authors also apply a new methodology to the examination of SDT, first they use new dynamic models that provide change over time for ecological structures and crime in a given neighborhood. They also look at the reciprocal effects between SDT and crime, meaning how the relationship between crime and community organization are connected. Next spatial interdependence between neighboring areas was examined. And lastly the authors examine the contextual effects on neighborhoods through individual level outcomes, meaning that the individual was looked at versus the neighborhood as a whole (Kubrin and Weitzer 2003). The authors find that with the added methodology and variables, SDT is now more than ever a viable theory to help explain why crime happens. And although they conclude that SDT should be applied to non-urban areas as well, they note that further research should be performed.

Continuing with current research that examines SDT, "Assessing Neighborhood Effects: Social Processes and New Directions in Research" (Sampson, Moreenoff, and Gannon-Rowley 2002) took 40 peer-reviewed journal articles from the mid 1990's to 2001 and incorporated the results to provide a better understanding of social processes that lead to delinquency in youth. To accomplish this the authors synthesize the results of the 40 articles on neighborhood studies. This synthetization happened by creating a classification system based on the following:

> (a) neighborhood-level studies with neighborhood process measures, in which both the dependent and independent variables are expressed as aggregate scales, counts, or rates across ecologically defined areas that are akin to neighborhoods; (b) multilevel studies with neighborhood process measures, in which sample members are nested within ecologically defined neighborhoods, the dependent variable is measured at the individual level, and the independent variables include both individual-level factors and aggregate level measures of neighborhood characteristics (both structure and process); and (c) multilevel studies with pseudo or proxy neighborhood-process measures, identical to the previous category except that social processes are actually measured at the individual level. (Sampson, Moreenoff, and Gannon-Rowley 2002, 448)

The authors conclude that more research and analysis need to be completed to better understand how social processes affect crime. However, they do have two takeaways from their research, first the methods used to look at the neighborhood-level foundations, is an acceptable form of measurement through survey and observation. Lastly, they find that "extra-local neighborhood mechanisms appear with considerable strength, suggesting that spatial externalities operate above and beyond the internal neighborhood characteristics of traditional concern" (Sampson, Moreenoff, and Gannon-Rowley 2002, p. 473). Noting that the problems within an individual neighborhood have the potential to cross into neighboring areas. This work was an amalgamation of 40 peer reviewed journal entries and was used as a starting point to look at more current research compiled on SDT.

More recent research that has examined SDT is "Extending Social Disorganization Theory: Modeling the Relationships between Cohesion, Disorder, and Fear*" (Markowitz 2001) which discusses a feedback loop within SDT. This loop, as described by the authors, starts with how crime and disorder affect fear of crime and how that fear interacts with neighborhood cohesion. They feel that the loop is ever escalating meaning that "decreases in cohesion increase crime and disorder, which increase fear, which in turn further decrease cohesion" (Markowitz 2001, 297). The data used for this study was taken from the BCS (the same survey that Sampson

and Groves used in 1989) in the years 1984, 1988, and 1992. The measures for disorder were calculated through five categories: noisy neighbors, teens hanging out on the streets, drunk people in public view, littering, and vandalism (Markowitz 2001). Within the survey the respondents that classified these as a "very big problem" were recorded and added across the five years to calculate a score (Markowitz 2001). Neighborhood cohesion was not always included in the BCS, to account for this three metrics were taken from the BCS that were contained in all three years of data used (1984,1988, and 1992) (Markowitz 2001). These measures included percent of people who went to a community meeting within the last week, percent of people who stated that they got along with their neighbors, and the percent of people who were very happy living in the area. These BCS responses were then used to calculate a z-score and added together to represent parts of neighborhood control and interaction (Markowitz 2001). Lastly fear was measured through three categories: percent of people who felt very unsafe when walking alone after dark, the percent of people who were very concerned about burglary, and the percent of people who were very concerned about being robbed (Markowitz 2001). It is of note that the SDT variable of SES was measured by neighborhood median income based on the British pound. The findings from the analysis show that "[c]ohesion shows a consistent negative effect, adding 7% to 10% to the explained variance in disorder" (Markowitz 2001,305-306). They also find that cohesion increases with median income.

Violence is a key aspect of this thesis and therefore "Extending Social Disorganization Theory: A Multilevel Approach to the Study of Violence among Persons with Mental Illnesses" (Silver 2000) is an important work to review. In this work Silver uses SDT to better understand violence in populations with mental illness. This is accomplished by assuming that community cohesion and social organization are a necessary part of protecting the neighborhood from the

violent behavior that may arise with mentally ill persons living in the area (Silver 2000). Meaning that family and friends of the mentally ill person or persons would be held accountable for controlling the actions of the mentally ill. Silver states "residents of socially organized neighborhoods are likely to act as guardians in attempting to control the behavior of teenaged peer groups, so too are such residents motivated to control the threatening or otherwise disruptive behaviors of persons with mental illnesses" (2000,1048). Silver uses a sample of people who were part of the MacArthur study, which took patients from the Western Psychiatric Institute and Clinic that had a major mental disorder. In this study each patient was interviewed several times to compile background data, the hospital charts were also used to verify their mental illness through official diagnosis (Silver 2000). The last part of the data gathering was completed by looking at official records to compile data about the patient's interaction within the community, such as arrest records or psychiatric hospitalizations. Silver found that patients that were released into neighborhoods with higher disorganization would be more likely to engage in violent activities, whereas a patient living in a more social organized neighborhood would be less likely to commit a violent act.

2.1.3 Application of Social Disorganization Theory In this Research

Pueblo, CO was chosen as a case study for SDT for two reasons. First, the use of one variable within the theory, SES. And secondly the fact that this theory applied early GIS techniques to test crime theory. The SES variable for this thesis was applied through housing costs, which will be discussed further in this chapter. SDT uses location to aid in the determination that it is in fact the "where" that is important in crime analysis. This "where" is determined by the concentric zone theory of city construction.

2.2 Spatial Analysis and Crime Data

Spatial analysis of crime data is a vast agglomeration of techniques used to determine where crime happens and attempts to explain why. This section discusses different techniques and methods and ultimately clarifies the spatial analysis approach to this research.

2.2.1 Spatial Analysis Techniques

The spatial analysis techniques that were decided upon for this thesis are Kernel Density Estimation and hot spot analysis. These are only two of techniques that can be used for crime mapping, and the following section discusses the literature that helps define these types of crime analysis, their applications, and uses.

Kernel Density Estimation (KDE) is a method that computes the density of features in an area surrounded by similar features (Esri 2018a). For crime mapping, KDE provides the density of crime instances in a given area (Ahmadi 2003). KDE works by placing a smooth surface over point or line features. The values are highest at an individual point and decrease as they move away from the point until zero is reached at the set search radius (Esri 2018a). This means that on a given map of crime one would see high values or "peaks" in areas that have many instances of crime and would see low values or "valleys" where there are few instances of crime. One main advantage to using KDE is the ease of use as well as resulting visualizations. A limitation to KDE is that the user may have the propensity to ignore the statistical values by being caught in its "visual lure" (Eck et al. 2005). The authors note that the KDE is considered to be the best interpolation method of crime data; however, the parameters, data type, boundaries, and other factors of analysis should lead the user to determine what type of analysis should be used (Chainey, Tompson, and Uhlig 2008).

KDE was determined not to be a suitable technique for this thesis because of the limitations that arise with Pueblo as a study area via the size of the city. KDE smoothed maps would have been visually appealing however, because of the spatial scale used for the study of Pueblo the data would not be a true representation of the real world. This problem of spatial scale of the crimes and study area required more precise technique to be used.

The techniques that are used in crime mapping include Point Mapping, Spatial Ellipses, Thematic Mapping of Geographic Boundaries, Quadrant Thematic Mapping, and Interpolation and Continuous Surface Smoothing. Point mapping is a digitized pin map that uses points to indicate an event that happened in a given area. Finding spatial patterns within the point data is difficult. This type of map is good for small scale analysis however, is not very viable for hot spot analysis without a spatial unit of analysis and reference (Eck et al. 2005).

Another technique is the "thematic mapping of geographic boundary areas," which uses a choropleth map to display crime data though aggregated statistical data in a given boundary such as a census block or police precinct. This type of crime map is best suited as a starting point for further analysis at the microlevel. Also, depending on the choice of the bounding geographic unit for analysis, the visualization and therefore resultant interpretation may vary greatly, hence representing an issue of the Modifiable Areal Unit Problem (MAUP) (Chainey, Tompson, and Uhlig 2008). The third technique "Grid Thematic Mapping" is a hot spot analysis that uses grids to adjust the different sizes of boundaries and hence address the MAUP that occur with thematic mapping. This technique, also referred to as "Quadrant Thematic Mapping" (Eck et al. 2005), uses a grid placed over the study area to create equal areas for analysis. The limitations to this technique include loss of spatial detail, and the visualization of the map has been described as blocky (Chainey, Tompson, and Uhlig 2008). According to John Eck and colleagues, a crime hot

spot is defined as “an area that has greater than the average number of criminal or disorder events” (2005, 2).

An additional method includes spatial ellipses (Chainey, Tompson, and Uhlig 2008). Spatial ellipses, while not statistical analysis, were used by an early crime mapping software called “Spatial and Temporal Analysis of Crime (STAC)” which in itself was not a GIS but rather a program to run in addition to a GIS. STAC looks to the densest area of point data and then places a standard deviational ellipse to these areas. This is similar to the Directional Distribution tool now available in ArcGIS Pro, which was utilized in this thesis. Early spatial ellipses indicate the size and orientation of the crime clusters. A main attraction of this type of analysis is that there is not a requirement of a boundary or unit of analysis such as police precincts, census tracks, or census blocks (Chainey, Tompson, and Uhlig 2008).

Getis Ord Gi* is a distance statistic used in hot spot analysis (Getis and Ord 1992). The statistic that the hot spot operation uses is the Getis-Ord-Gi*(G-i-Star), which as explained from Esri produces p-scores and z-scores that inform a user of high and low clusters of spatial data (Esri 2018b). By looking at neighboring features or crime points as in this thesis, the G-i-Star will determine if a point contains a high value, and if that high value point is surrounded by other high value points a hot spot is marked. These calculations (Equation 1-3) uses high positive z-scores to denote hot spots and negative z-scores to denote cold spots, both of which would be considered statistically significant.

$$G_i^* = \frac{\sum_{j=1}^{n} \omega_{i,j} x_j - \bar{x} \sum_{j=1}^{n} \omega_{i,j}}{s\sqrt{\left[\frac{n\sum_{j=1}^{n} \omega_{i,j}^2 - \left(\sum_{j=1}^{n} \omega_{i,j}\right)^2}{n-1}\right]}} \qquad \text{(Eq 1)}$$

In this equation $\mathcal{X}j$ is the attribute value for feature $j, \omega_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features, s^2 is the variance and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad \text{(Eq 2)}$$

$$s = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{x})^2} \quad \text{(Eq 3)}$$

The Gi* Statistic requires no further calculations because it is a z-score (Esri, 2018b).

A case study that utilized the Getis Ord Gi* statistic was "Dwelling Unit Prices in San Diego County by Zip-Code Area, September 1989." This case study examined housing prices within San Diego County and assigned high and low z-score values based on these housing values (Getis and Ord 1992). They found that housing values did not disperse in a uniform way from the downtown area.

2.3 Social Disorganization Theory and Socioeconomic Status

Using housing values as an indicator of socioeconomic status (SES) was a logical decision based on its connection to SDT. It can be concluded that areas within a city that have low or very low housing values would be considered areas of poverty and less desirable in which to live. This section will discuss literature that covers why housing values are a natural indicator of SES.

Property value is an important part of SES, partly because homes are the most valuable asset a person or family can attain and the location and cost of said home are largely based on the individual or family income (Vernez Moudon et al. 2011); and higher income individuals or families can buy more expensive homes in much nicer areas of a city or suburb. Vernez Moudon

et al. (2011) use housing values as a way to track SES at the individual level instead of at neighborhood levels. In one study examining how crime impacts the housing market, the authors found that homebuyers are willing to spend more money on housing if there is less violent crime (Ihlanfeldt and Mayock 2010). This theory is further discussed in a study conducted in Barcelona, Spain which also examines housing values and crime (Buonanno et al. 2012). This study found that a single positive standard deviation in perceived security gives an increase in housing value of 0.55-0.76% of the actual value. The authors do mention that "the results here consistently indicate that crime perception negatively affects housing prices" (Buonanno et al. 319).

And in the last study that was examined "The Property Wealth Metric as a Measure of Socieo-Economic Status*"* (Coffee et al. 2018) the authors examine health and property values in a small area within South Australia, Adelaide. The housing values were calculated using the sales of homes within the study area. This study built on the work by Vernez Moudon et al. and found additional evidence that housing values have potential to indicate SES.

These three studies add credence to the fact that SES and housing values are connected to crime rates. Thus, housing value will be used as an indicator of SES status in Pueblo, CO. These housing values will be discussed further in Sections 3.1.3 and results provided in 4.4.

Chapter 3 Methods

This chapter summarizes the data used in this study, the methods used in processing prior to incorporating into the GIS, and the analyses and visualization methods. The aim of this research was to test for a spatial relationship between low housing values (low SES) and high violent crime rates in the City of Pueblo and specifically to examine if: 1) crime rates have changed over time; 2) the changes in crime rates have a spatial pattern; and 3) the change in crime rates mirror housing values.

The overall workflow (Figure 6) consisted of first importing the shapefiles and point data into ArcGIS Pro, the shapefile of the city limits was then used to create the four PPD quadrants based on the diagram that was provided by the PPD. The address points were imported and used for the address locator in the geocoding of the crime data. Prior to geocoding, the crime data set was cleaned by removing any non-supported characters (such as punctuation and parentheses symbols) in the data, as ArcGIS Pro will not import the data if they are included. The data were also organized by year and separated into individual spreadsheets prior to the aggregation of the crimes by type. Next, the data were analyzed through histograms and summary statistics. The data were then imported into ArcGIS Pro, geocoded, and visually represented. Next a Fishnet was created for each of the top violent crimes both for the total years and annually. The fishnet grid cells were then spatially joined to the crime point data that they corresponded with. The final step was to then run the hot spot analysis for the total crimes, annual crime, and top crime types. Housing value data was the next set of variables that needed to be processed. Each of these steps are described further in the sections below. Results are presented in Chapter 4.

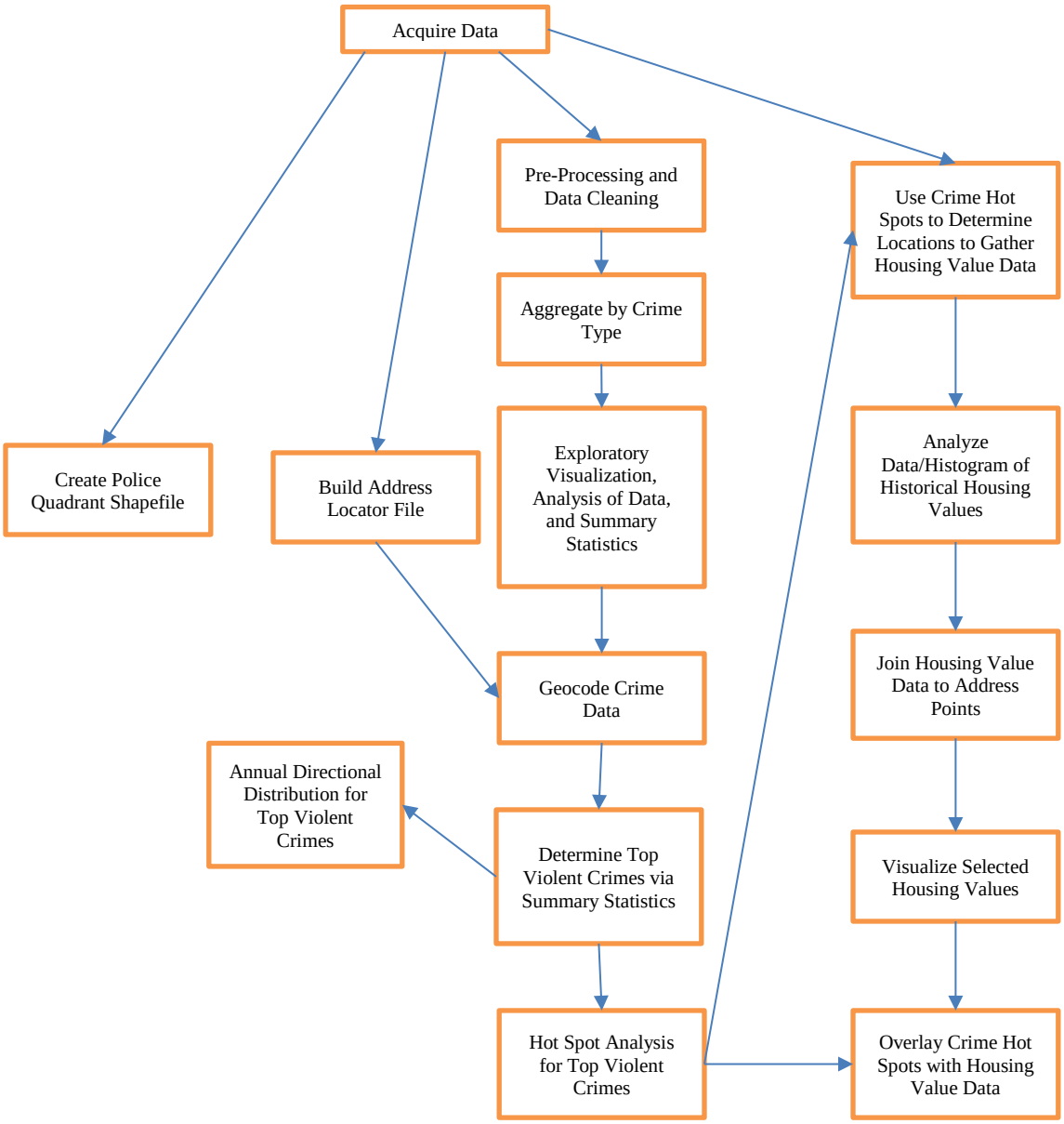

Figure 6-Workflow Diagram for Data Processing and Analysis

3.1 Data Sets

Many different data sources were needed to analyze crime occurrence and economics in Pueblo, CO. Table 2 consists of a complete list of the data sets that were collected, created, and analyzed for this thesis, along with processing required for each dataset used. Crime data were provided by the PPD's crime analyst. Shapefiles for Pueblo city limits were downloaded from the city's GIS web portal. The address points for the geocodes were also taken from this portal.

The fourth dataset was the housing values data, which are discussed at length later in this section, the housing data were obtained from the County of Pueblo GIS department's interactive mapping system (IMS).

3.1.1 Crime Data Processing and Aggregation

To determine the locations of high crime rates, it was necessary to attain individual crime data records across the eleven-year period (2006-2016). This was achieved via a partnership with the City of Pueblo Police Department's Crime Analyst Micaela Leffler. Ms. Leffler provided this project with crime location (except for reported rape, which was removed from the analysis), date, time, and offence type, which was then used to visualize the spatial distribution of violent crimes. This crime dataset included more than 13,000 incidents of crime, which included all property and violent crimes that were recorded over the given time span.

Table 2. Data Sets

Data:	**File-Type**	**Created By**	**Date Created**	**Last Modified**	**Acquired From**	**Use**
County Limits	Shape File-Polygon	U.S. Department of Commerce, U.S. Census Bureau, Geography Division, Geographic Products Branch	2015	27 June 2018	U.S. Census Bureau	Used as a spatial reference and clipping
City Limits	Shape File-Polygon	Kyle Good	February 2018	27 June 2018	City of Pueblo GIS Office	Used to help create police department quadrant shape file
Police Quadrants	Shape File-Polygon	Dane Cornell	01 July 2018	01 July 2018	Pueblo City Limits Polygon	
Neighborhoods	Shape File-Polygon	Debi Romines	06 October 2017	27 June 2018	City of Pueblo GIS Office	
Crime Instances	Excel Spreadsheet	Micaela Leffler	19 March 2018	20 March 2018	Pueblo Police Department's Crime Analyst	Converted to crime point data
Address Points	Shape File-Point	Kyle Good	13 December 2012	04 March 2018	City of Pueblo GIS Office	Reference for geocoding crime points
Housing Values	CSV Spreadsheet	Dane Cornell	01 October 2018	28 September 2018	Pueblo County Assessors Interactive Web Map	Used as a socioeconomic indicator through conversion to point data

The two major types of crime that are defined are property crime and violent crime. Property crime is "a category of crime in which the person who commits the crime seeks to do damage to or derive an unlawful benefit or interest from another's property without using force or threat of force" (US Legal, Inc. 2018), and violent crime is "a behavior by persons, against persons or property that intentionally threatens attempts, or actually inflicts physical harm" (US Legal, Inc. 2018). Because violent crime has a much larger impact on society than property or non-violent crimes and is less likely to be correlated with commercial areas where property crimes occur, only violent crimes are analyzed in this thesis. Additionally, taking violent crime and separating it from crime as a whole provides a better picture of the connection of SES to violent crime and allows for the micro-level analysis. Violent crimes, in general, will be discussed in detail in the next few paragraphs to explain how they affect the safety of the population. The violent crimes from the data initially were broken down into over 100 individual types of crime. Due to improper and duplicate labeling, several of the crime types were simply labeled slightly differently but were the same crime and could therefore be collapsed together. This left 33 distinct violent crimes differentiated between first-degree (1st Deg) and second-degree (2nd Deg) offenses. The crime data that was provided by the PPD was lacking a unique identifier (code) that is needed for processing in a GIS, so this was added without ranking and irrespective of internal police codes (See Table 3). Crimes will be referenced by their assigned code (identifier).

Table 3. Crimes by Category

Category	Crime Code	Crime Type	Total Number of Crimes
Violent Crime	1	1ST DEG BURGLARY	127
Violent Crime	2	1ST DEG KIDNAPPING	19
Violent Crime	3	1ST DEG MURDER	38
Violent Crime	4	1ST DEG SEXUAL ASSAULT- SEX ASSAULT - SODOMY - BOY - GUN	3
Violent Crime	5	1ST DEG AGG MOTOR VEHICLE THEFT	240
Violent Crime	6	1ST DEG ASSAULT	138
Violent Crime	7	1ST DEG CRIMINAL ATTEMPT MURDER	87
Violent Crime	8	1ST DEG FORCIBLE RAPE	13
Violent Crime	9	2ND DEG BURGLARY	1399
Violent Crime	10	2ND DEG KIDNAPPING	88
Violent Crime	11	2ND DEG MURDER	15
Violent Crime	12	2ND DEG AGG MOTOR VEHICLE THEFT VALUE $1,000 TO $20,000	472
Violent Crime	13	2ND DEG ASSAULT	790
Violent Crime	14	2ND DEG CRIMINAL ATTEMPT MURDER	60
Violent Crime	15	2ND DEG ASSAULT HEALTH WORKER	12
Violent Crime	16	AGG ROBBERY	273
Violent Crime	17	AGG ASSAULT	119
Violent Crime	18	ASSAULT	2
Violent Crime	19	BURGLARY	44
Violent Crime	20	DUI - ACCIDENT	10
Violent Crime	21	HOMICIDE	15
Violent Crime	22	INTIMIDATE WITNESS/VICTIM	37
Violent Crime	23	KIDNAPPING	11
Violent Crime	24	KIDNAPPING - KIDNAP ADULT FOR RANSOM	1
Violent Crime	25	LARCENY/THEFT - PURSE-SNATCHING	4
Violent Crime	26	ROBBERY	240
Violent Crime	27	SEX OFFENSE	42
Violent Crime	28	SEXUAL ABUSE ON A CHILD	1
Violent Crime	29	SEXUAL ASSAULT	44
Violent Crime	30	SEXUAL ASSAULT-VICTIM BETWEEN 15 AND 17 YRS. OLD	8
Violent Crime	31	UNLAWFUL SEXUAL CONTACT	63
Violent Crime	32	VEHICULAR ASSAULT-DUI	16
Violent Crime	33	VEHICULAR HOMICIDE	10

DEG= Degree; AGG=Aggravated; DUI=Driving Under the Influence

From an initial data exploration, it was determined that this subset of 33 crimes was still too large to find statistical significance, due to the large discrepancy in the total number of crimes year to year (Figure 7). Many crime types had a very low total count, creating outliers in the normal distribution of the data. Because of this loss of statistical significance, the top violent

crimes were used for analysis. It is necessary to note that there were two crime types tied in fifth place with 240 total counts, Robbery and First-Degree Aggravated Motor Vehicle Theft. The five crime types with the highest occurrence rates were: Robbery (26, N=240) and First-Degree Aggravated Motor Vehicle Theft (5, N=240), Aggravated Robbery (16, N=273), Second Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 (12, N=472), Second-Degree Assault (13, N=790), and Second-Degree Burglary (9, N=1399) (Figure 8).

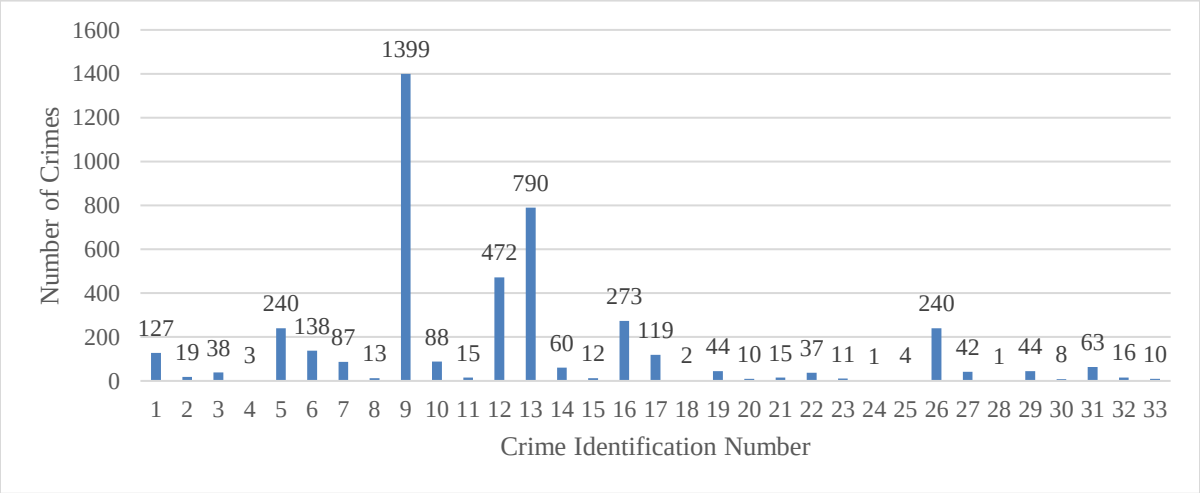

Figure 7-Number of Crimes by Category

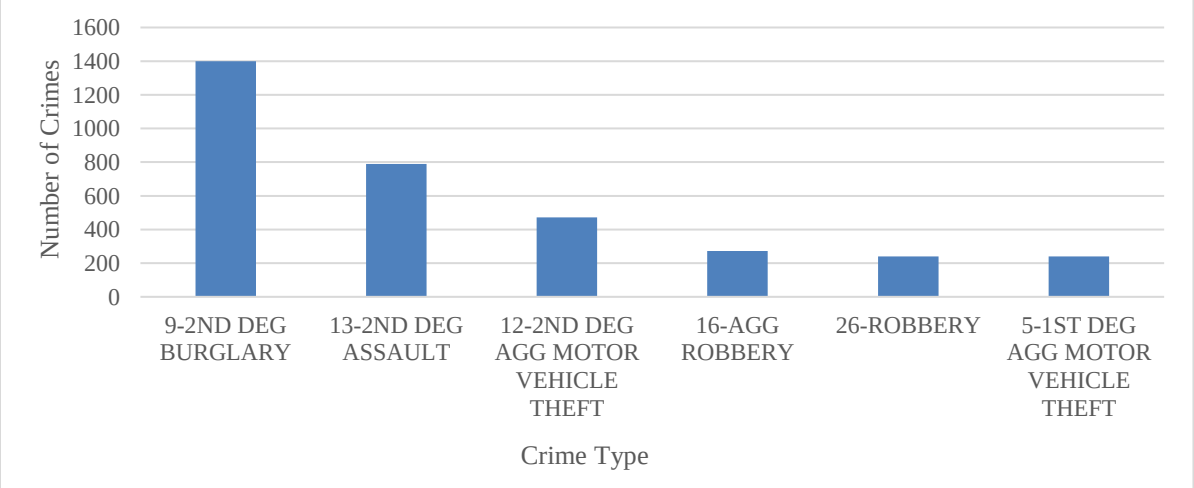

Figure 8-Total Counts of Top Violent Crime Types

It is necessary to define each of these crimes to understand why they are considered violent crimes. The FBI defines Robbery as "the taking of or attempting to take anything of value from the care, custody, or control of a person or persons by force threat of force or violence and/or putting the victim in fear" (Federal Bureau of Investigation 2018). Aggravated Robbery is, according to the Colorado Revised Statutes (CRS) 18-4-302:

> when a person commits Robbery and also with a weapon with intent-if faced with resistance- to kill, maim, or wound the person robbed; or knowingly wounds or strikes another with a deadly weapon; or uses force, threats, or intimidation with a deadly weapon and knowingly put another person in reasonable fear of death or bodily injury; or represents that he or she is armed with a deadly weapon or possesses an object meant to look like a weapon. (2019)

First-Degree Aggravated Motor Vehicle Theft is, according to CRS 18-4-409:

> A person commits Aggravated Motor Vehicle Theft in the first-degree if he or she knowingly obtains or exercises control over the motor vehicle of another without authorization or by threat or deception and retains possession or control of the motor vehicle for more than twenty-four hours; or attempts to alter or disguise or alters or disguises the appearance of the motor vehicle; or attempts to alter or remove or alters or removes the vehicle identification number; or uses the motor vehicle in the commission of a crime other than a traffic offense; or causes five hundred dollars or more property damage, including but not limited to property damage to the motor vehicle involved, in the course of obtaining control over or in the exercise of control of the motor vehicle; or causes bodily injury to another person while he or she is in the exercise of control of the motor vehicle; or Removes the motor vehicle from this state for a period of time in excess of twelve hours; or unlawfully attaches or otherwise displays in or upon the motor vehicle license plates other than those officially issued for the motor vehicle. (2019)

Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 is, according to CRS 18-4-409 (2019) "as knowingly obtain or exercise control over someone else's car, truck, motorcycle or other vehicle either without authorization or by threat or deception and the aggravating factors of First-Degree Aggravated Motor Vehicle Theft are not present in the act of committing the crime." Second-Degree Assault is, according to CRS 18-3-203:

> a person "intentionally" or "recklessly" causes bodily injury to another by means of a deadly weapon, with intent to cause bodily injury, you cause serious bodily

> injury, cause bodily injury to anyone while intentionally trying to prevent a police officer or firefighter from doing their duties, "knowingly" apply "physical, violent force" to a police officer, firefighter, prison guard, or a judge while they are in the performance of their duties, or intentionally drug someone without their consent. (2019)

Lastly, CSR 18-4-203 (2019) defines the crime of Second-Degree Burglary as "if the person knowingly breaks an entrance into, enters unlawfully in, or remains unlawfully after a lawful or unlawful entry in a building or occupied structure with intent to commit therein a crime against another person or property." These crimes all have a possibility to be considered violent, or they are directly a violent crime such as assault. Because of how a person can be charged with any of these six crimes, for the purposes of this analysis all six are considered violent crime.

3.1.1.1 Geocode

The Excel spreadsheets of crime data were imported into Esri's ArcGIS Pro and a spatial reference was added using the Geocode tool with in ArcGIS Pro. The original crime data only contained physical address locations of crime (Figure 9), which was composed of street address and zip codes, which served as a reference point for the Geocoding. The Geocode tool adds a spatial reference to data that previously had no coordinates to do so and changes physical addresses to X and Y locations. To successfully add latitude and longitude to the crime data it was necessary to build an "Address Locator File." This address locator served as the reference point for the Geocoding. There are many approaches to creating the address locator, for this analysis it was determined that the "US Address-One Range" style would be best, because this type of address locator would be the correct match with the information contained in the violent crime data. The Geocoded addresses for Pueblo were available from Pueblo's GIS department's web portal. Once this file was downloaded it was imported into the File Geodatabase. The

Address Locator file was created from the Geocoded address for the city, by running the “Create Address Locator” tool.

To geocode the crime data the “input table” was selected as the top violent crimes CSV sheet, the “input address locator” was selected as the Pueblo Address (created previously), the “input address fields” were selected as single field and the FULLADDR attribute from the crime data was selected, and then the tool was ran. Results were returned with an accuracy rate of 76%, leaving roughly 700 addresses that needed to be manually located and given X and Y coordinates. This manual process was completed with the “Rematch Address” tool, which allows the user to go to the map and manually place points at their proper locations. Google Maps was used to reference the unmatched address for location accuracy; the unmatched address would be looked up on the Google system then a satellite image base map was loaded in ArcGIS Pro. Once the base map was loaded the location on Google Maps would be found and finally a point would be added in ArcGIS Pro for that unmatched point. This process was done for all the unmatched address points. An example of the pre and post geocoded data can be viewed in Figures 9 and 10.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	GEOID	GEOID2	GEOID3	YEAR	DATE_REPTOFFECNCE	OFFECNCE	VIOLENT_Y_N	VIOLENT_OFFENCE_CODE	OFFENCE_CODE	FULLADDR	streetnbr	street	city	state	zip
2	11	1		2006	1/6/2006 15:30	SEX OFFENSE	Y	113	228	1705 CYPRESS ST	1705	CYPRESS ST	PUEBLO	CO	81004
3	14	2		2006	1/6/2006 23:51	ASSAULT IN THE 1ST DEG-POLICE/FIRE-WEAPON	Y	64	88	627 E 4TH ST	627	E 4TH ST	PUEBLO	CO	81001
4	17	3		2006	1/8/2006 0:35	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	1130 W 13TH ST	1130	W 13TH ST	PUEBLO	CO	81003
5	24	4		2006	1/10/2006 15:57	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
6	39	5		2006	1/14/2006 0:45	LARCENY/THEFT - PURSE-SNATCHING	Y	89	177	2330 LAKE AVE	2330	LAKE AVE	PUEBLO	CO	81004
7	51	6		2006	1/17/2006 7:53	AGGRAVATED ASSAULT-NONFAM-STRGARM	Y	51	72	538 BELMONT AVE	538	BELMONT AVE	PUEBLO	CO	81004
8	55	7		2006	1/18/2006 13:43	SEX OFFENSE	Y	113	228	1500 LAKEVIEW AVE	1500	LAKEVIEW AVE	PUEBLO	CO	81004
9	74	8		2006	1/22/2006 2:09	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	2305 LAKE AVE	2305	LAKE AVE	PUEBLO	CO	81004
10	107	9		2006	1/28/2006 21:57	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	2505 E ORMAN AVE	2505	E ORMAN AVE	PUEBLO	CO	81004
11	128	10		2006	2/4/2006 0:49	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	1705 SCHLEY ST	1705	SCHLEY ST	PUEBLO	CO	81004
12	143	11		2006	2/9/2006 2:25	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	1806 BLAKE ST	1806	BLAKE ST	PUEBLO	CO	81003
13	146	12		2006	2/10/2006 18:11	SEX OFFENSE	Y	113	228	2206 E 14TH ST	2206	E 14TH ST	PUEBLO	CO	81001
14	164	13		2006	2/17/2006 13:18	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
15	170	14		2006	2/19/2006 3:58	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	2431 CALIFORNIA ST	2431	CALIFORNIA ST	PUEBLO	CO	81004
16	177	15		2006	2/21/2006 19:43	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	1917 COURT ST	1917	COURT ST	PUEBLO	CO	81003
17	195	16		2006	2/28/2006 19:35	ROBBERY - STREET - GUN	Y	102	217	1200 BONFORTE BLV	1200	BONFORTE BLV	PUEBLO	CO	81001
18	215	17		2006	3/5/2006 16:12	CRIMINAL ATTEMPT 2ND DEG MURDER - WILLFUL - WEAPON	Y	75	102	2701 VINEWOOD LN	2701	VINEWOOD LN	PUEBLO	CO	81005
19	220	18		2006	3/7/2006 23:10	AGGRAVATED ASSAULT-NONFAM-STRGARM	Y	51	72	1911 W 12TH ST	1911	W 12TH ST	PUEBLO	CO	81005
20	224	19		2006	3/8/2006 16:40	SEX OFFENSE	Y	113	228	1006 BONFORTE BLV	1006	BONFORTE BLV	PUEBLO	CO	81001
21	225	20		2006	3/8/2006 17:02	AGGRAVATED ASSAULT-NONFAM-STRGARM	Y	51	72	1633 E 3RD ST	1633	E 3RD ST	PUEBLO	CO	81001
22	227	21		2006	3/9/2006 14:06	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
23	230	22		2006	3/9/2006 19:03	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	1033 E EVANS AVE	1033	E EVANS AVE	PUEBLO	CO	81004
24	231	23		2006	3/10/2006 1:25	SEX OFFENSE -STATUTORY RAPE NO FORCE	Y	116	231	2207 E 12TH ST	2207	E 12TH ST	PUEBLO	CO	81001
25	247	24		2006	3/15/2006 16:20	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	1211 CARTERET AVE	1211	CARTERET AVE	PUEBLO	CO	81004
26	251	25		2006	3/17/2006 14:47	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
27	256	26		2006	3/19/2006 3:11	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	400 W 16TH ST	400	W 16TH ST	PUEBLO	CO	81003
28	261	27		2006	3/21/2006 12:15	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
29	263	28		2006	3/21/2006 23:19	DUI - ACCIDENT	Y	76	141	4000 N I25 SB	4000	N I25 SB	PUEBLO	CO	81008
30	271	29		2006	3/25/2006 22:20	AGGRAVATED ASSAULT-FAM-STRGARM	Y	50	71	705 HUNTER DR	705	HUNTER DR	PUEBLO	CO	81001
31	272	30		2006	3/26/2006 21:56	ROBBERY - BUSINESS - GUN	Y	95	210	2105 OAKSHIRE LN	2105	OAKSHIRE LN	PUEBLO	CO	81001
32	273	31		2006	3/27/2006 1:41	AGGRAVATED ASSAULT-WEAPON	Y	56	77	626 RIVER ST	626	RIVER ST	PUEBLO	CO	81001
33	278	32		2006	3/29/2006 9:48	ROBBERY - BUSINESS - WEAPON	Y	97	212	1545 S PRAIRIE AVE	1545	S PRAIRIE AVE	PUEBLO	CO	81005
34	286	33		2006	3/31/2006 5:09	HOMICIDE - WILLFUL KILL-FAMILY-GUN	Y	80	163	2019 MOHAWK RD	2019	MOHAWK RD	PUEBLO	CO	81001
35	287	34		2006	3/31/2006 13:59	SEX OFFENSE	Y	113	228	130 CENTRAL MAIN ST	130	CENTRAL MAIN ST	PUEBLO	CO	81003
36	295	35		2006	4/1/2006 19:52	SEXUAL ASSAULT-SEXUAL INTRUSION/PENETRATION	Y	124	239	41 IRONWEED DR	41	IRONWEED DR	PUEBLO	CO	81005
37	320	36		2006	4/8/2006 1:12	AGGRAVATED ASSAULT-NONFAM-WEAP	Y	52	73	628 E 4TH ST	628	E 4TH ST	PUEBLO	CO	81001
38	329	37		2006	4/11/2006 17:58	ROBBERY - BUSINESS - STRONGARM	Y	96	211	3301 DILLON DR	3301	DILLON DR	PUEBLO	CO	81008
39	331	38		2006	4/11/2006 23:38	ASSAULT IN THE 2ND DEG-BODILY INJURY W/WEAPON	Y	68	92	722 E 2ND ST	722	E 2ND ST	PUEBLO	CO	81001
40	337	39		2006	4/13/2006 11:59	BURG-FORCED-RESID	Y	73	97	1105 PINE ST	1105	PINE ST	PUEBLO	CO	81004

Figure 9-Crime Data CSV Sheet

OBJECTID	Shape	ObjectID	Status	Score	Match_type	Match_addr	Addr_type	AddNum	X	Y	DisplayX	DisplayY	Xmin	Xmax	Ymin	Ymax	IN_Street
1	Point	2065	M	100	A	1704 1704 PALMER A...	SubAddress	1704	3249969.333603	1573692.280426	3249969.338349	1573692.298473	0	0	0	0	1704 PALMER AVE
2	Point	2145	M	100	A	1717 1717 E ORMAN...	SubAddress	1717	3252468.159229	1572746.344742	3252468.16406	1572746.362373	0	0	0	0	1717 E ORMAN AVE
3	Point	385	M	100	A	1426 1426 E 21ST ST,...	SubAddress	1426	3263473.065968	1591220.903112	3263473.072168	1591220.921552	0	0	0	0	1426 E 21ST ST
4	Point	575	M	100	PP	x=3259519.242902, y...	SubAddress	819	3259519.185069	1587513.387717	3259519.190968	1587513.406658	0	0	0	0	819 E 10TH ST
5	Point	578	M	100	A	1806 1806 E 5TH ST,...	SubAddress	1806	3264572.235269	1585898.481143	3264572.241558	1585898.50011	0	0	0	0	1806 E 5TH ST
6	Point	1608	M	100	A	1325 1325 WEST ST,...	SubAddress	1325	3253605.877025	1588530.099805	3253605.881929	1588530.118863	0	0	0	0	1325 WEST ST
7	Point	2277	M	93.32	A	515 515 E ROUTT AV...	SubAddress	515	3253195.781321	1578837.507143	3253195.786292	1578837.525715	0	0	0	0	515 W ROUTT AVE
8	Point	1516	M	100	A	1201 1201 THOMAS...	SubAddress	1201	3240666.550854	1587918.372028	3240666.556429	1587918.390428	0	0	0	0	1201 THOMAS AVE
9	Point	2272	M	100	A	1321 1321 LAKEVIEW...	SubAddress	1321	3250683.667071	1572299.230965	3250683.67255	1572299.248766	0	0	0	0	1321 LAKEVIEW AVE

Figure 10-Geocoded Crime Data Displayed in ArcGIS Pro

3.1.2 Housing Data

Housing data for Pueblo was collected from the Pueblo Counties Economic Development and Geographic Information Systems (EDGIS) online interactive mapping system (IMS). This system was accessed through Pueblo County's web page where the Pueblo County Assessor has property and parcel information, including several housing value options. The four variables that were of use to this project were Land Assessed Value, Land Actual Value, Improvements Assessed Values, and Improvements Actual Values. These variables were determined to be the only values needed because they represent the housing values. The difference between the

assessed and actual land and improvements are that the assessed value is what the property tax is based on and the actual values are what the property would sell for. For the purposes of this project the sale value was decided on because it represents the SES better than tax value.

The areas for which data were needed were determined by the results of the hot spot analysis results for crime (Section 4.3). Once assessed, the hot spot 25m by 25m grid was overlaid on the IMS map of Pueblo and two hot spot areas for each crime type were determined. Major cross streets were used as boundaries in the IMS for selecting housing value areas and from the aerial map individual city blocks were identified within the hot spot of the given crime type. Each area of housing data contained four individual grid cells from the hot spot. Once these areas were determined the IMS was used to select housing value data by city blocks. After this data was selected a CSV file was created for each set of 4 grid cell hot spot areas. At this time areas that were not statistically significant for hot spots were determined as well and a sample of housing values for these areas was taken for reference.

The IMS provided all of the data for each city block in an exportable CSV file as well as a web-based view (Figures 11 and 12), these files were the data used for analysis.

Figure 11-Web-Based Data View of Housing Variables

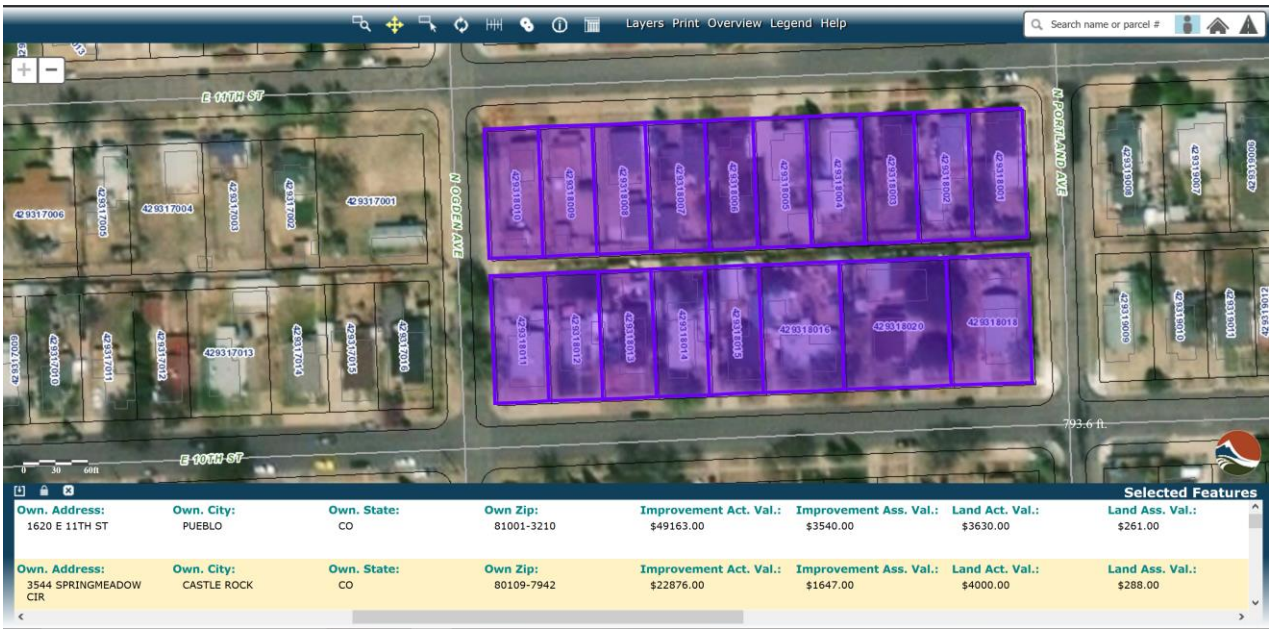

Figure 12-Example of Collection of Housing Data Through the Pueblo County Assessors Interactive Map

After the data for each city block within the hot spot was collected and downloaded as a CSV file, they were combined into one file. This was done for two hot spots within each crime type, for a result of ten sample areas for which housing value data was collected. These CSV files were then imported in to ArcGIS Pro to be visualized.

Historical housing values were also collected at this time. To collect the historical values dating from 2006 to 2016 it was necessary to take a random 10% sample of the individual properties in both the hot spots and the non-significant areas. The 10% threshold was decided upon through the total number of properties in the dataset. This was completed by creating an Excel spreadsheet with the parcel number and corresponding years property values. At this point the historical housing data was analyzed via histogram to show the year-to-year change. Next the housing data was imported into ArcGIS Pro for visualization.

3.2 Data Visualization and Analysis

To determine the spatial pattern, if any, of crime distribution in Pueblo, first a Directional Distribution was run and then Hot Spot Analysis was conducted. Several Directional Distributions were created from the top violent crime point data to examine the distribution of the crime instances year to year. These Directional Distributions were created using the Directional Distribution (Standard Deviational Ellipse) tool within ArcGIS Pro. This tool created individual ellipses for each year (2006-2010) and were displayed on the base map. Each year was represented by different colored ellipses to allow analysis of the distribution of violent crimes. The data for the hot spot analysis was processed through ArcGIS Pro's Hot Spot Tool. First it was necessary to ensure that the data was complete and had spatial relationships. This was accomplished by first running directional distributions on the violent crime data. These directional distributions showed a spatial relationship between each year of violent crime data. Next it was necessary to create a grid system to divide the study area into equal areas, this was done with the "Create Fishnet" option within ArcGIS Pro. The "Create Fishnet" operation requires several inputs from the user. There are several different ways to create this grid, first is to determine the origin coordinates and then pick the cell size. A second option is to pick the number of columns and rows based on the current map projection. Several row and column combinations were tried and finally a 25m by 25m cell size was decided on based on the size of Pueblo. After the Fishnet was created the crime points were spatially joined to the fishnet for further analysis. This was done by copying the violent crime point file and spatially joining it to the Fishnet. Spatial joins work by taking the target feature, in this case the Fishnet layer, and "joining" it to another layer through the "join features" option which would be the crime point layer in this case, lastly a one-to-one join was used for the crime data. The one to one join was

used because the locations of the crimes are based on single address points within the Fishnet. The address points are X and Y coordinates within the Fishnet to allow for the join to happen. The hot spot operation within ArcGIS Pro requires an input class- the joined fishnet, an input field- Join_Count (the total number of incidents that are contained within each cell of the fishnet), the output file name, the distance method (which was left as the default "Euclidean", and the conceptualization of Spatial relationships (also left as the default "Fixed Distance Band"). The final step in the hot spot analysis was to run the hot spot operation within ArcGIS Pro.

The hot spot operation analyzes hot and cold spots within the created fishnet grid. These hot and or cold spots represent statistically significant areas in the data through clustering of incidents, which in this case would be the individual violent crime locations. There were no cold spots in the analysis preformed on any of the years or crime locations, this will be discussed further in Chapter 5.

In ArcGIS Pro, the housing value data was joined to the previously used address point layer to give the housing values a spatial reference. The two files were joined on the parcel number attribute. This join allowed for the housing data to be visualized. The final step to this process was to overlay the hot spots with the housing data to visualize the locations of both the hot spots and the housing values.

Chapter 4: Results

After examining the locations of violent crimes in Pueblo, it was clear that there were hot spots of crimes. Housing values were gathered for select hot spots for each crime type to determine the "economic value" of the areas. It was found that the houses in these areas hold much less value than that of the median home value for Pueblo as a whole. These housing variables aided in determining what would be considered high and low economic areas for the city.

4.1 Violent Crime Temporal Trends

Initial exploration of the dataset showed a general upward trend in all violent crimes 2006-2016 (Figure 13). The trend shows that the top four violent crime types have a percent change of more than 200% with First-Degree Aggravated Motor Vehicle Theft having a rate of change at 816% and Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 at 757%. The bottom two types have a much lower rate of change with Robbery decreasing by 4%. These large increases in crime rates beg the question as to where they are happening, and ultimately a possibility of why they are happening.

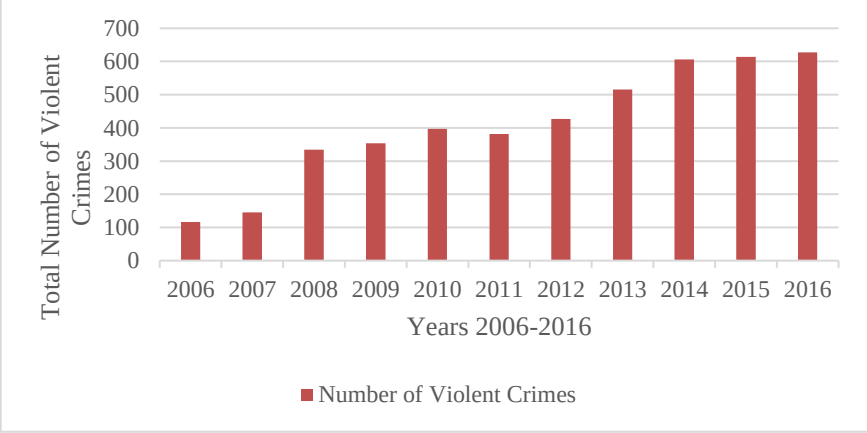

Figure 13-Violent Crimes by Year

Second-Degree Burglary had the highest count of incidents over the 11 year time frame. With a count of 1399 incidents across the city Second-Degree Burglary was reported zero times in 2006 and 2007; and increased year over year with a large jump between 2009 and 2010 increasing from 88 to 135 instances. The next several years show a slow increase until 2013 to 2014 which jumped from 167 to 233 instances of this crime (Figure 14). The following two years saw a slight decrease to 231 and 205 respectively.

The second highest violent crime type for Pueblo from 2006 to 2016 was Second-Degree Assault with a total count of 790. This violent crime was extremely low in 2006 and 2007 with only 4 and 8 instances respectively. 2008 witnessed an exponential jump to 58 instances followed by 84 for 2009. In 2010 there is a small increase to 94, followed by a drop to 78 in 2011. 2012 to 2016 the instances are as follows 90, 101, 93, 88, and 92 (Figure 14).

Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 is the third highest violent crime with a count of 472 instances over the 11-year span. 2006 and 2007 both saw zero reported instances of this crime. Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 was then reported 14 times in 2008 and 24 times in 2009. There was a drop to 17 instances in 2010 and then again, an increase to 23 reported crimes in 2011. In 2012 there is a large jump to 40 followed by an increase every year after. In 2013 there were 64 instances, 2014 had 74, 2015 had 96, and finally 2016 witnessed a jump to 120 (Figure 14). It should be noted here that Pueblo has not only had an Aggravated Motor Vehicle Theft problem but a Motor Vehicle Theft problem as well. A 2017 report by the PPD shows that between 2013 and 2017 4,493 vehicles were stolen from in and around the city largely due to people leaving their vehicles running on cold mornings (Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 is not included in these numbers) (City of Pueblo Police Department 2018).

Aggravated Robbery is fourth, with total instances of crime at 273 with 2006 and 2007 having zero instances. Starting in 2008 there were 10 crimes of this type followed by 23 in 2009, a decrease to 21 in 2010, back up to 26 in 2011, 29 in 2012, 39 in 2013, 40 in 2014, down three to 73 in 2015, and up to 48 in 2016 (Figure 14).

Robbery and First-Degree Aggravated Motor Vehicle Theft tie for lowest in the rankings of violent crime for Pueblo, each with a total instance count of 240.

Overall the top violent crimes for Pueblo fluctuated in number of instances year to year, with some violent crimes increasing much more than others. When looking at the percent change for the top violent crimes for the City of Pueblo from 2006 to 2016 there is an interesting trend that comes forward, there is a large increase in three, and moderate increase in one, and a decrease in one. The breakdown of the crimes is as follows: First-Degree Aggravated Motor Vehicle Theft 816%, Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 757%, Aggravated Robbery 380%, Second-Degree Burglary 205%, Second-Degree Assault 58.6%, and Robbery -4%.

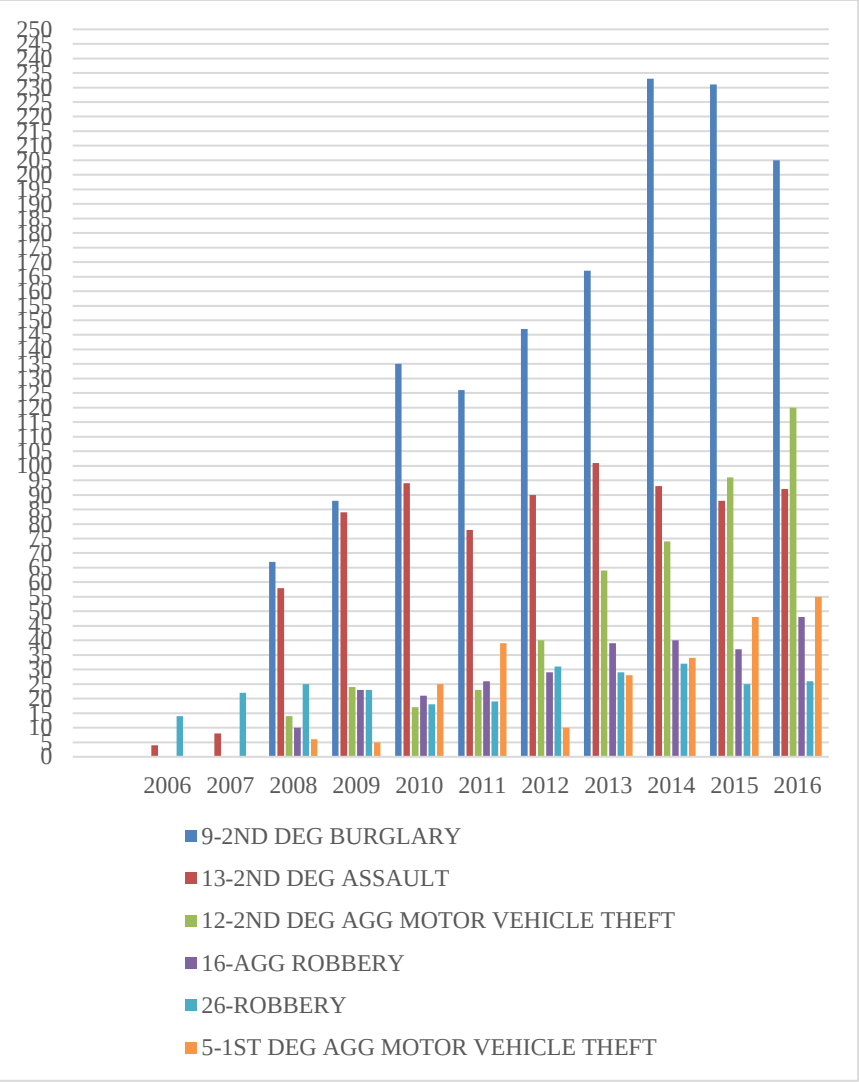

Figure 14-Top Violent Crimes by Year

The following sections visualize the data to display the results from the spatial analysis. Section 4.1 examines the actual locations of the top violent crimes. Section 4.2 shows the results of the Directional Distribution of the top violent crimes for 2006-2016. Section 4.3 examines the results of the hot spot analysis. And lastly Section 4.4 shows the results of overlay of the crime hot spots and housing values.

Figure 15 displays the top violent crime locations for the years 2006 to 2016. Looking at this figure it can be deduced that violent crime happens across the city. However, once broken

down into individual crime types these crimes seem to be further separated and clustered in different areas. This clustering will be discussed in further detail in Section 4.3. These crime points represent individual crime locations over an eleven-year period within the city limits of Pueblo, CO. The city limits are broken down further into PPD Quadrants, which have been discussed in detail in Section 1.1.1 of this thesis. Figure 15 is a map of PPD quads and all violent crime locations and does not show any clustering or spatial patterns. This map has been included in this text for display purposes only.

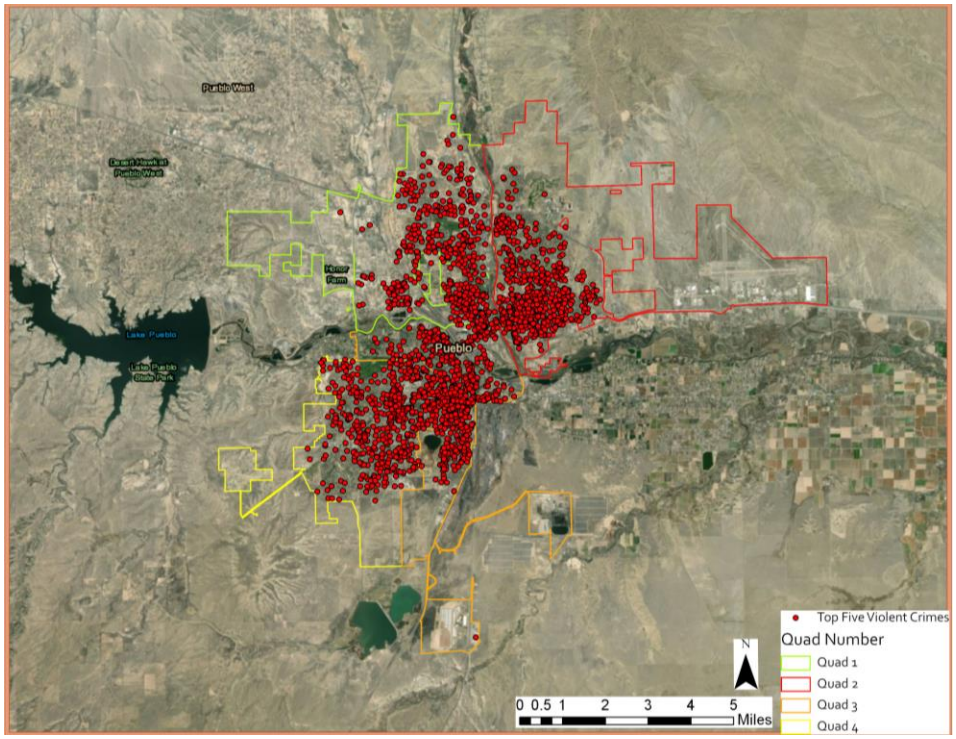

Figure 15-Top Violent Crime Locations for 2006-2016 with PPD Quadrants

4.2 Directional Distribution

The Directional Distributions for the violent crimes (Figure 16 and 17) in Pueblo do not indicate much change year to year with the exception to Second-Degree Assault and Robbery. Second-Degree Assault seems to constrict in the latter years of the study, (2006 and 2007 are

outliers when examined visually). 2006 is very much in the middle of the distribution, one cause of this may be the low number of instances that occurred in that year, also the locations of these crimes are very much centered in the downtown area of Pueblo. 2007's difference can also be explained by the low instances of crimes; however, these crimes were much more spread across the city. Robbery sees a shift to the north in 2014, where the previous and later years see a much tighter and similar distribution throughout the city. Aggravated Robbery also shows a slight shift to the north in its distribution, much the same as Robbery. The shift in both of these crime types moves in the direction of the major shopping area located on the Northside of Pueblo.

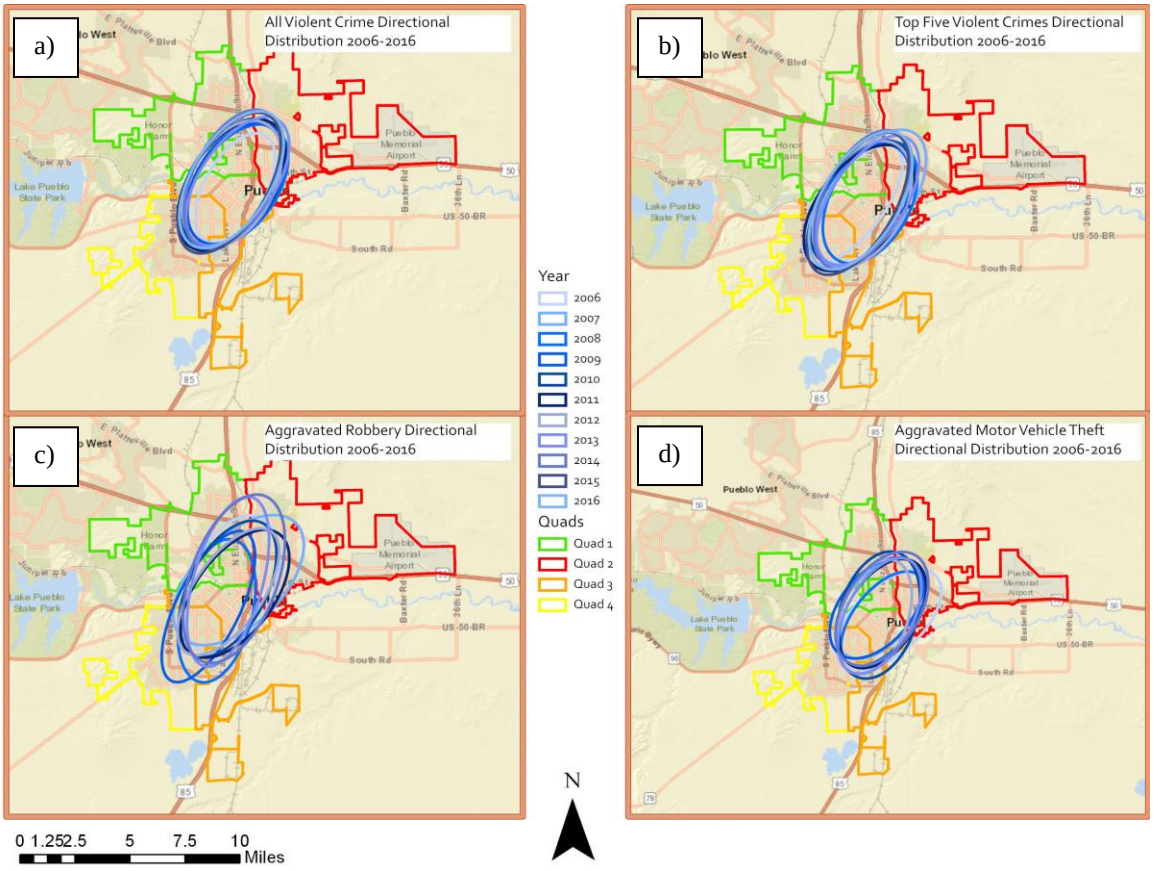

Figure 16-Directional Distribution of Crimes by Type and by Year a) All Violent Crime, b) Top Violent Crimes, c) Aggravated Robbery, and d) Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000

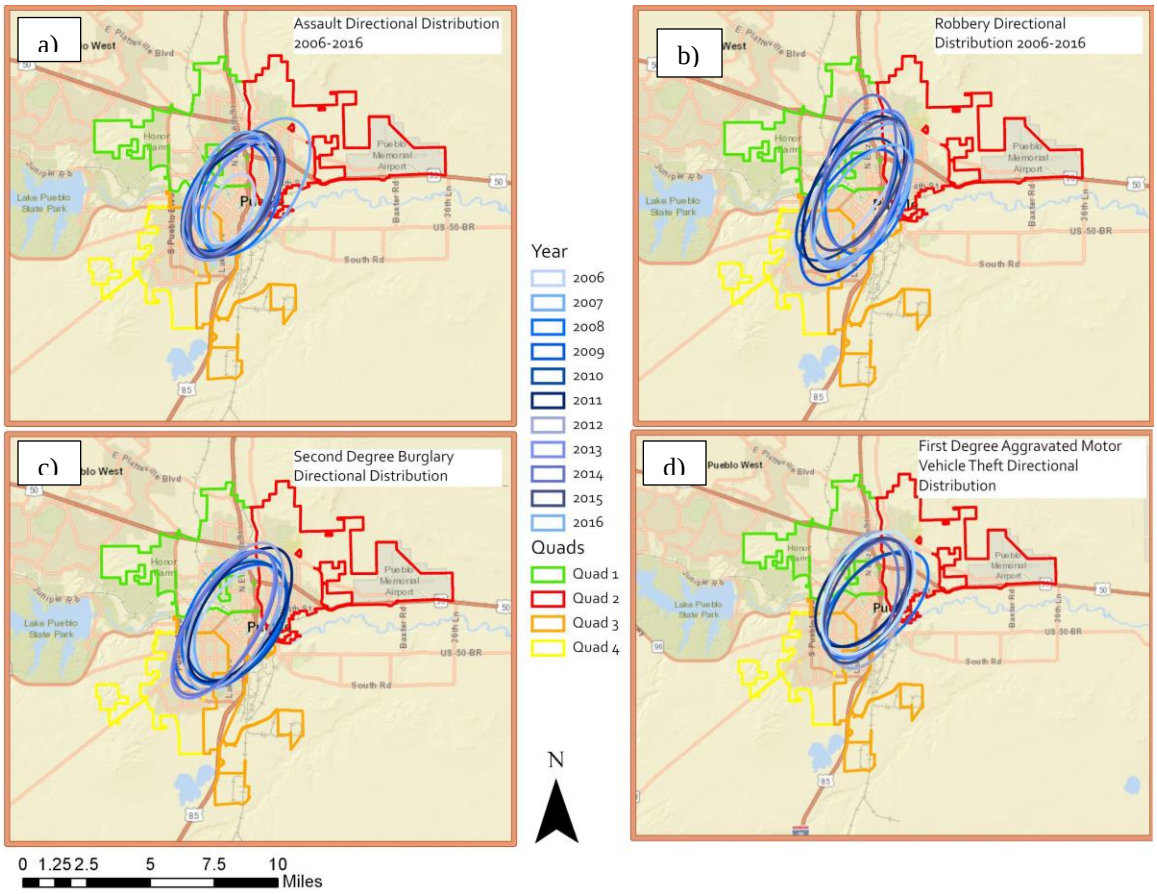

Figure 17-Directional Distribution of Crimes by Type and by Year: a) Second-Degree Assault, b) Robbery, c) Second-Degree Robbery, and d) First-Degree Aggravated Motor Vehicle Theft

4.3 Hot Spot Analysis

The hot spot analysis shows areas that have the highest accumulations of violent crime. There are two areas of the city that stood out from the rest, specifically the Downtown/Eastside and Central/South area of Pueblo which fall into several police quadrants. There is one hot spot that falls outside of these areas, which is around a shopping area. For the purposes of this thesis, only the areas that fall within residential areas were examined in conjunction with the housing values. This decision was made because the property values in these areas are not home values, they are commercial properties which for the purposes here do not indicate SES. In Section 4.4 this housing variable will be discussed in more detail.

The first hot spot examined is the total of the top violent crimes for 2006-2016 (Figure 18) and shows several hot spots throughout the city. These hot spots cross police quads and are spread across the city. There are several areas that need to be noted. First the two small clusters that are in quad one and partially into quad two are in the north of town. These areas contain mostly commercial buildings and shopping areas, although perpetrators of these crimes may live in close proximity, there is no way of knowing this and therefore no way of linking criminals to a specific area. One could potentially examine surrounding housing values; however, some would argue that this does not test SDT, and is beyond the scope of this thesis. The next hot spot splits three police quads (1, 2, and 3) and is located in the Central/Downtown area as well as the east of town, these areas contain some commercial properties but are primarily residential. The last area of hot spot was located in the Southwest area of Pueblo, again this area contains some commercial properties but is mostly residential. It is then necessary to look at each violent crime type individually, which the following figures provide. It should be noted that the violent crime hot spot analysis did not produce any cold spots for the study area. This is because the lack of low negative Z-scores and small P-values within the data. The Z-scores for the hot spots showed high values, indicating clustering of crimes in these areas. Again, the lack of low Z-scores indicate that there are no cold spots. An example of the P-values and Z-scores were taken from the top violent crime types. The Z-score mean for this hot spot was 0.011718, a median of 0.702828, with a standard deviation of 1.421116. The Z-score had a high of 0.509096 with a count of 386 incidents of crime within the hotspot, the low for the Z-score was 6.667434. As for the P-value for the same top violent crime types had a mean of 0.430262, a median of 0.419023, with a standard deviation of 0.215471.

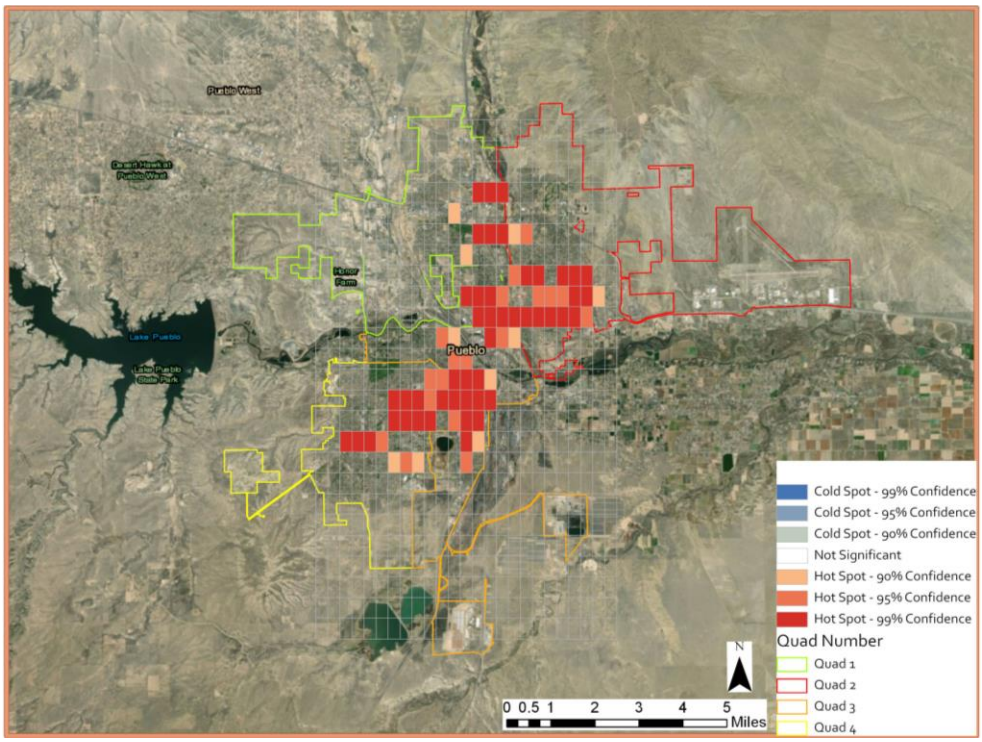

Figure 18-Top Violent Crimes Hot Spot Analysis for 2006-2016

The first violent crime that was analyzed was Second-Degree Burglary. There were many hot spots in the 90% confidence range throughout the city, these we are less concerned about, the 99% confidence areas are where further analysis was performed. Hot spots that fall within the 99% range are the most statically significant of the group. For this particular hot spot map two areas within police quads two, three, and four were used as an index for where housing value data would be collected (discussed further in Section 4.4). This analysis provided interesting analysis, initially it was hypothesized that this crime would have hot spots in the 99% confidence range in mostly residential areas. However, the hot spots were split between both residential and commercial areas. The largest concentration of hot spots did however fall within a residential area, which would ultimately be used to gather housing data. This hot spot analysis is visualized in Figure 19.

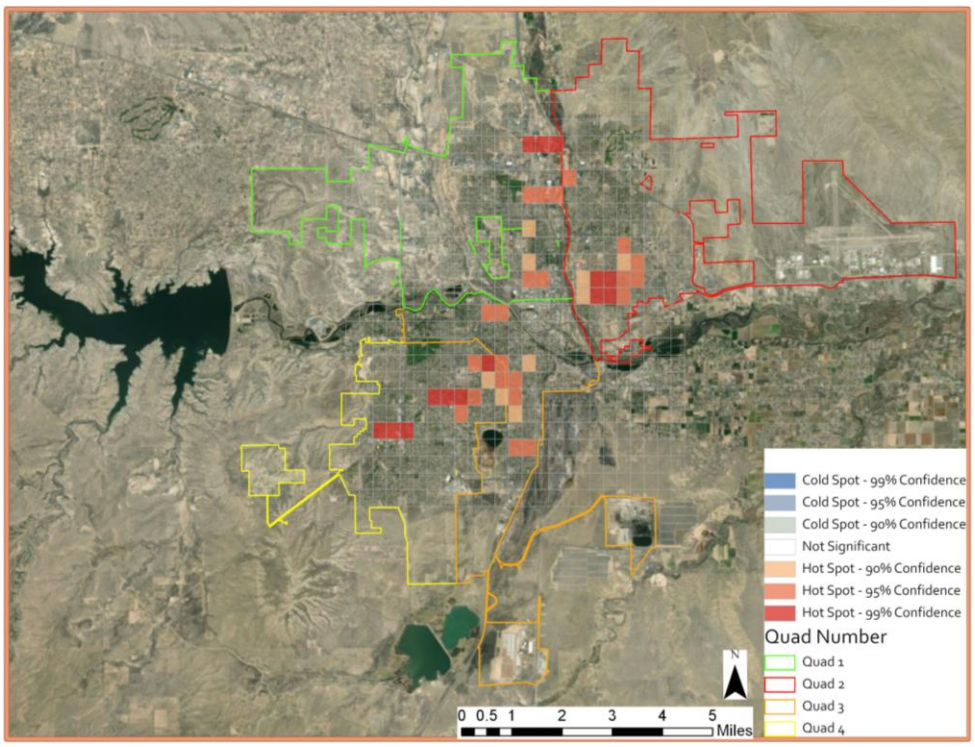

Figure 19-Second-Degree Burglary Hot Spot Analysis for 2006-2016

The next crime type analyzed was Second-Degree Assault. The results were spread across the Downtown and Eastside of Pueblo as well as the South-Central area. These areas contain a large number of bars and drinking establishments mixed into residential areas. This crime is spread across all 4 police quadrants (Figure 20).

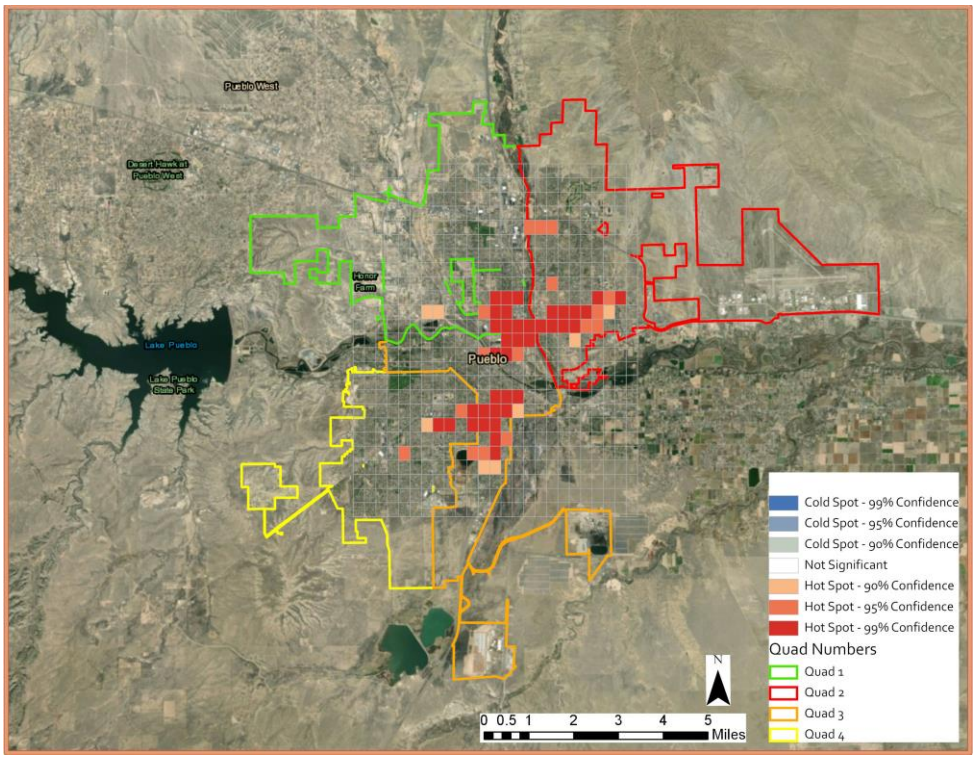

Figure 20-Second-Degree Assault Hot Spot Analysis for 2006-2016

Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 is the next violent crime examined, and this crime type by far had the most hot spots at the 99% confidence throughout the city. The majority of the cells that are displayed fall into the 99% range, with only one cell falling below at a 95% range. This crime happened within all 4 police quadrants and saw a very high concentration in the Eastside of town. This hot spot analysis is displayed in Figure 21 located below.

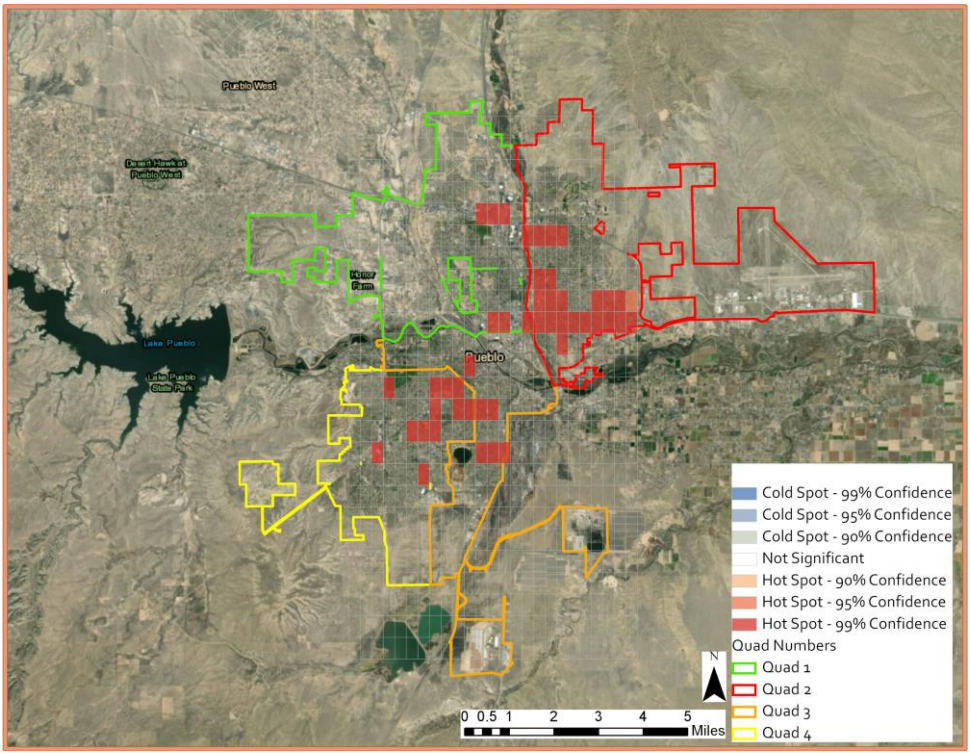

Figure 21-Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000 Hot Spot Analysis for 2006-2016

First-Degree Aggravated Motor Vehicle Theft was the next violent crime analyzed with the hot spot function. This crime was spread across all 4 police quadrants, with areas clustered on the Eastside of Pueblo all in the 99% range. One thing of note with this analysis is the cluster of four grid cells in quadrant one, this area is home to the majority of auto dealerships in Pueblo. Making it a prime area for this type of crime to occur.

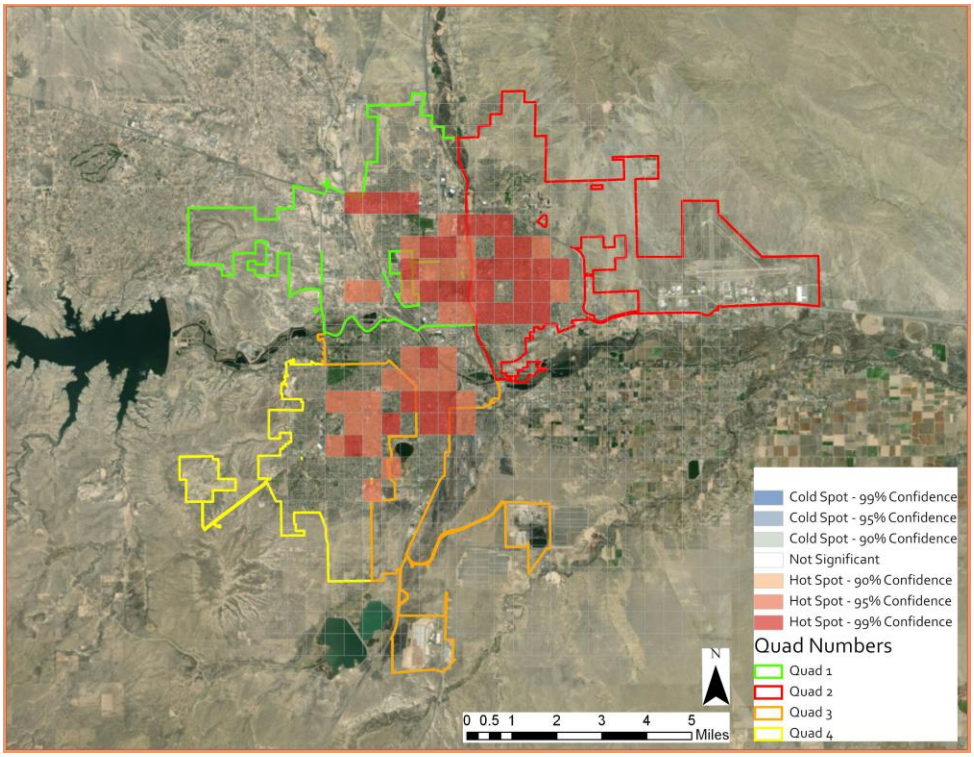

Figure 22-First-Degree Aggravated Motor Vehicle Theft Hot Spot Analysis for 2006-2016

The next two crime types are Aggravated Robbery and Robbery (Figures 23 and 24). These crime type hot spot analyses provided similar results to many of the hot spots at the 99% confidence range within commercial and shopping areas. There were a few hot spots that do fall within residential areas. Because of the small number of hot spots within residential areas no housing values were collected for these two crime types. It was determined that because of the value of commercial buildings and the fact that SDT does not center around commercial property as a variable that these areas would not have data collected on property value. Overall the hot spot analysis provided insight as to where and which violent crimes were statistically significantly clustered in Pueblo, Colorado.

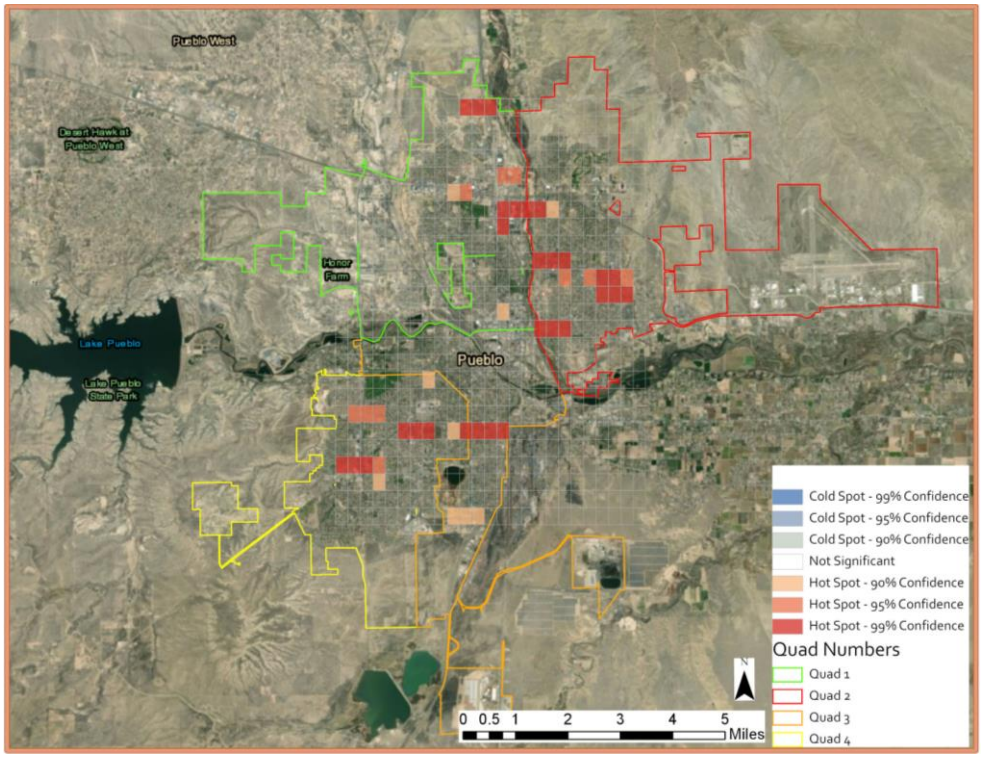

Figure 23-Aggravated Robbery Hot Spot Analysis for 2006-2016

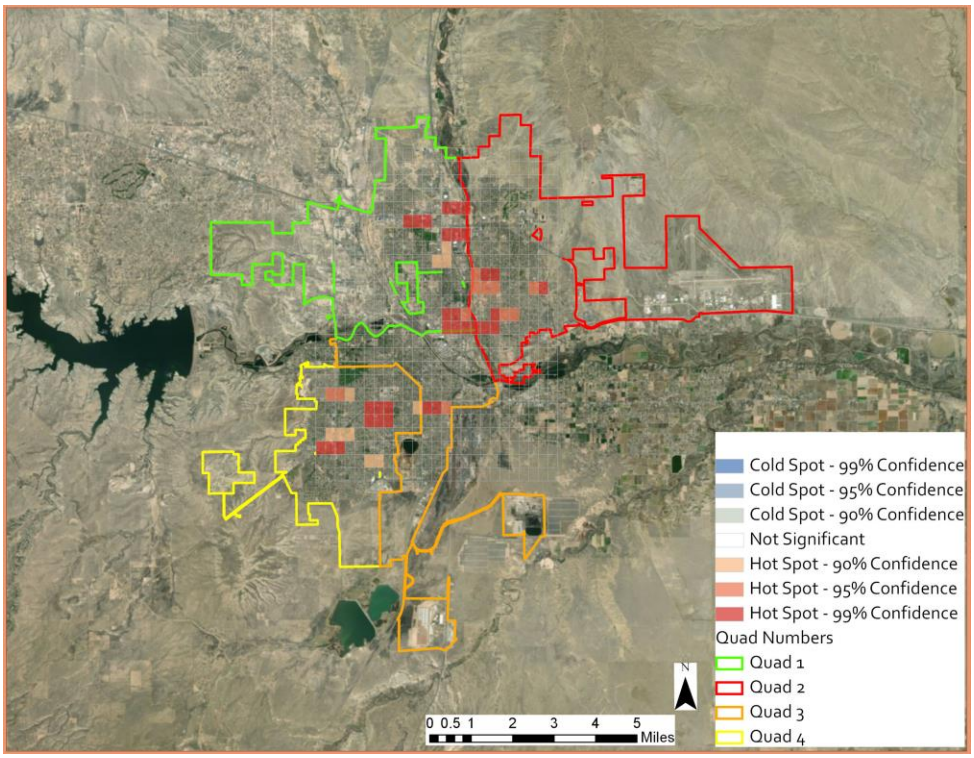

Figure 24-Robbery Hot Spot Analysis for 2006-2016

4.4 Crime Hot Spots and Housing Values

Housing values are a key variable for this thesis, as they represent the SES variable within SDT and act as an indicator for poverty. For the purposes of this thesis the hot spots discussed in Section 4.3 were used as a designation for where to collect the housing value data. For each crime type four adjoining grid cells were selected for two hot spots, and the 2016 housing values for individual properties were selected for these areas. Figure 25 is an example of one cell of the hot spot where housing values were collected. Figures 26 through 29 provide a visualization of the hot spots overlaid with the collected housing data. It should be noted that two of the violent crimes, Second-Degree Assault and Robbery, do not have a visualized overlay because of the lack of hot spots that were located in residential areas, this is because the majority of the hot spots contained commercial areas. Also, Aggravated Robbery only has one section of housing values because a second hot spot of four cells was not available for selection primarily because many of these hot spots fall within commercial areas.

Figure 25-Example of Housing Values for a Hot Spot in Pueblo, CO one Cell of the Fishnet Grid

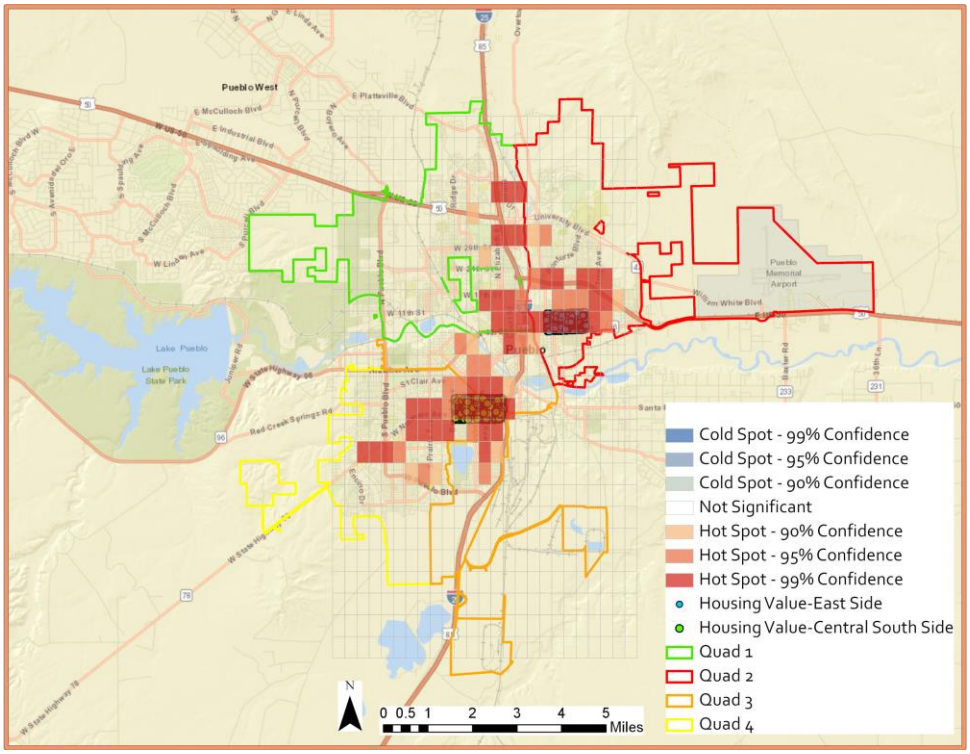

Figure 26-Housing Values Overlaid with Hot Spot Analysis of the Top Violent Crimes

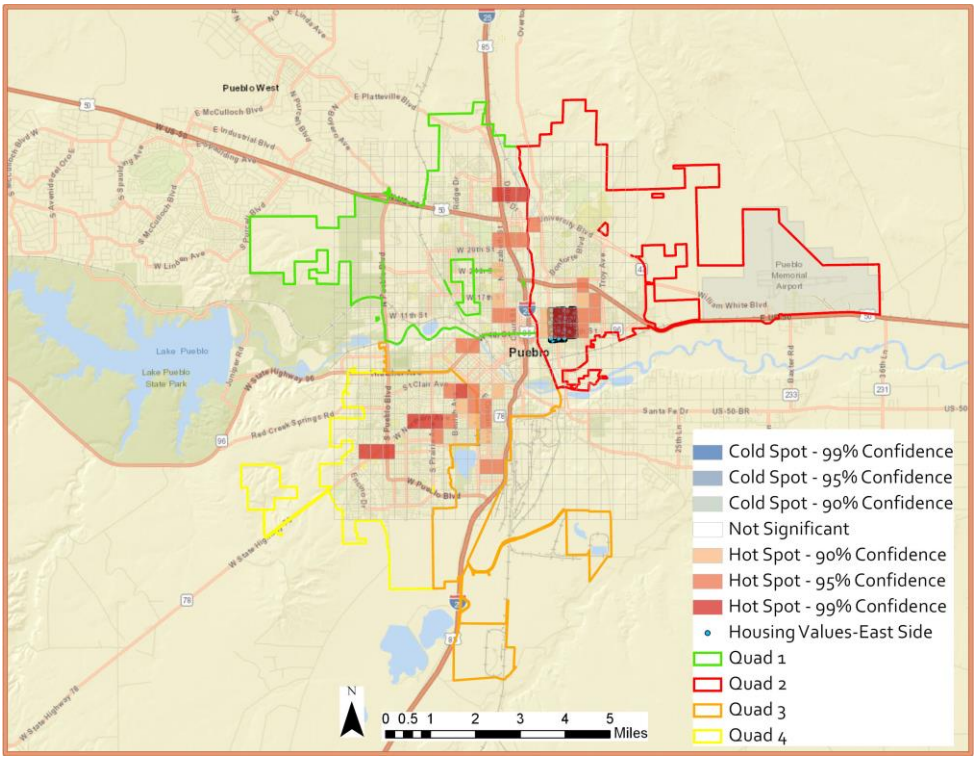

Figure 27-Housing Values overlaid with Hot Spot Analysis of Second-Degree Burglary

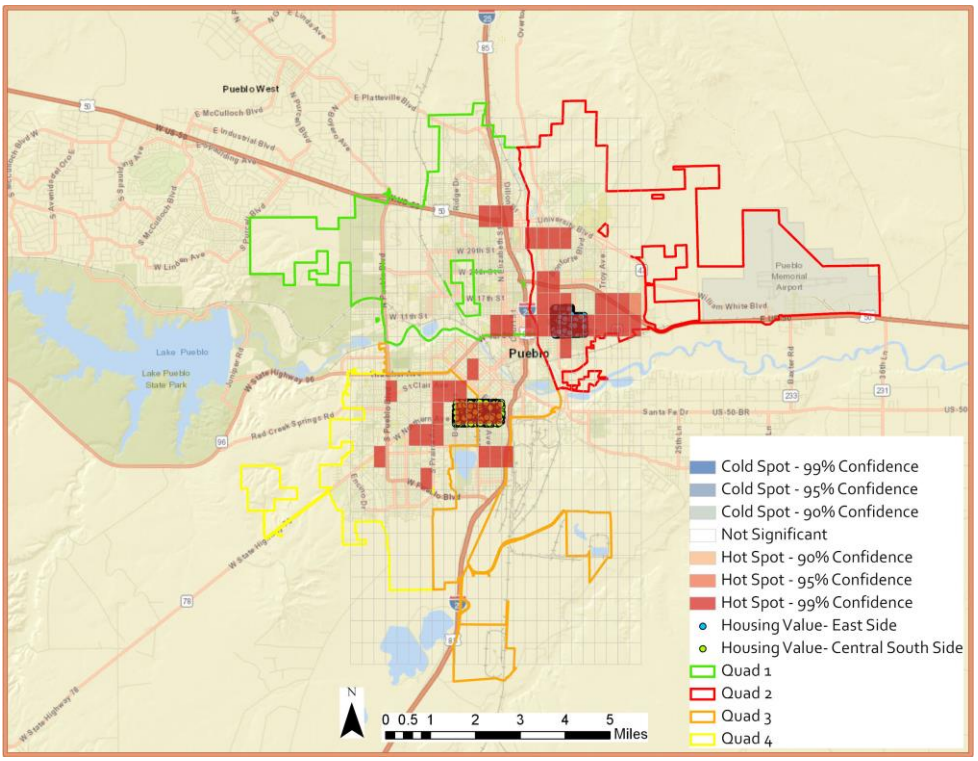

Figure 28-Housing Values Overlaid with Hot Spot Analysis of Second-Degree Aggravated Motor Vehicle Theft Value $1000 to $20,000

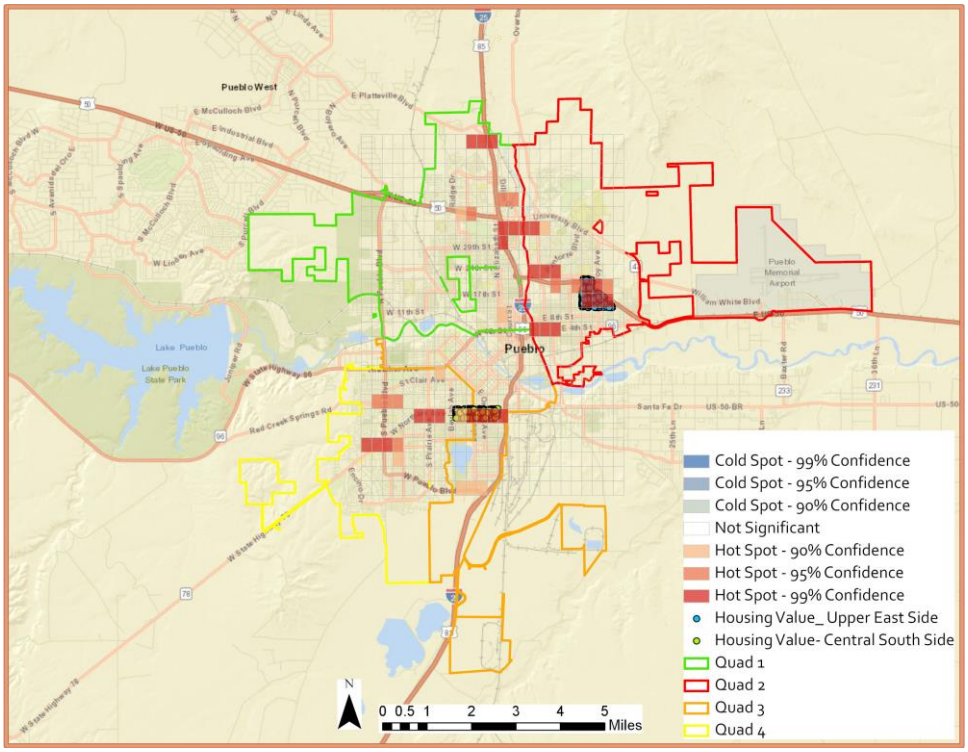

Figure 29-Housing Values Overlaid with Hot Spot Analysis of Aggravated Robbery

After gathering the housing values for two hot spots for each crime it was necessary to look at the historical value of the homes in these areas. This was accomplished through the use of Pueblo County's IMS. A 10% sample of properties were gathered from an area that all five crime types shared hot spots or were very close to one another. This sample was comprised of 50 individual properties, from these properties a value for 2006, 2008, 2010, 2012, 2014, and 2016 were taken. After all the values had been collected, each year was averaged to build the graph in Figure 30. The results provided the evidence to show that housing values decreased in the same time frame that violent crimes increased.

In contrast to the decreasing home values in hot spot areas, home values in non-statistically significant areas increased. The same process was followed for the non-statistically significant areas. The historical home values were collected, summed, and averaged to provide a graph that indicates the increase in home value. This graph is provided as Figure 31. The graph

shows that home values did decrease over the same time, but the averages show an overall increase in value. Also, the homes in the non-statistically significant areas have a much higher overall value than the homes in the hot spot areas. As shown in both figures the highest price of a home in a crime hot spot area is approximately $82,000 in 2008 where a home in a non-statistically significant area is much higher at approximately $158,000. This gap is even more profound if we look at the 2016 home values of both areas, where we see a hot spot area with a value of approximately $64,000 and a non-statistically significant area with a value of approximately $150,000 over double the value of a home in a hot spot area. In the non-statistically significant areas we also see a large rise in value from 2012 to 2016 where the hot spot area sees nowhere near as large of jump in value.

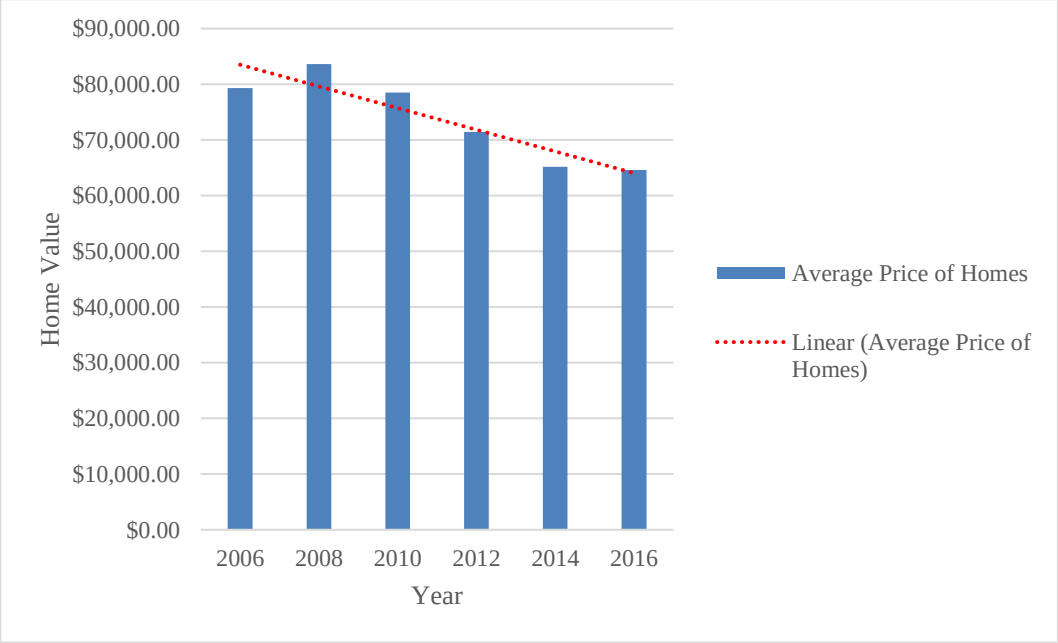

Figure 30-Average Housing Value for a Sample Hot Spot Area of Pueblo, Colorado

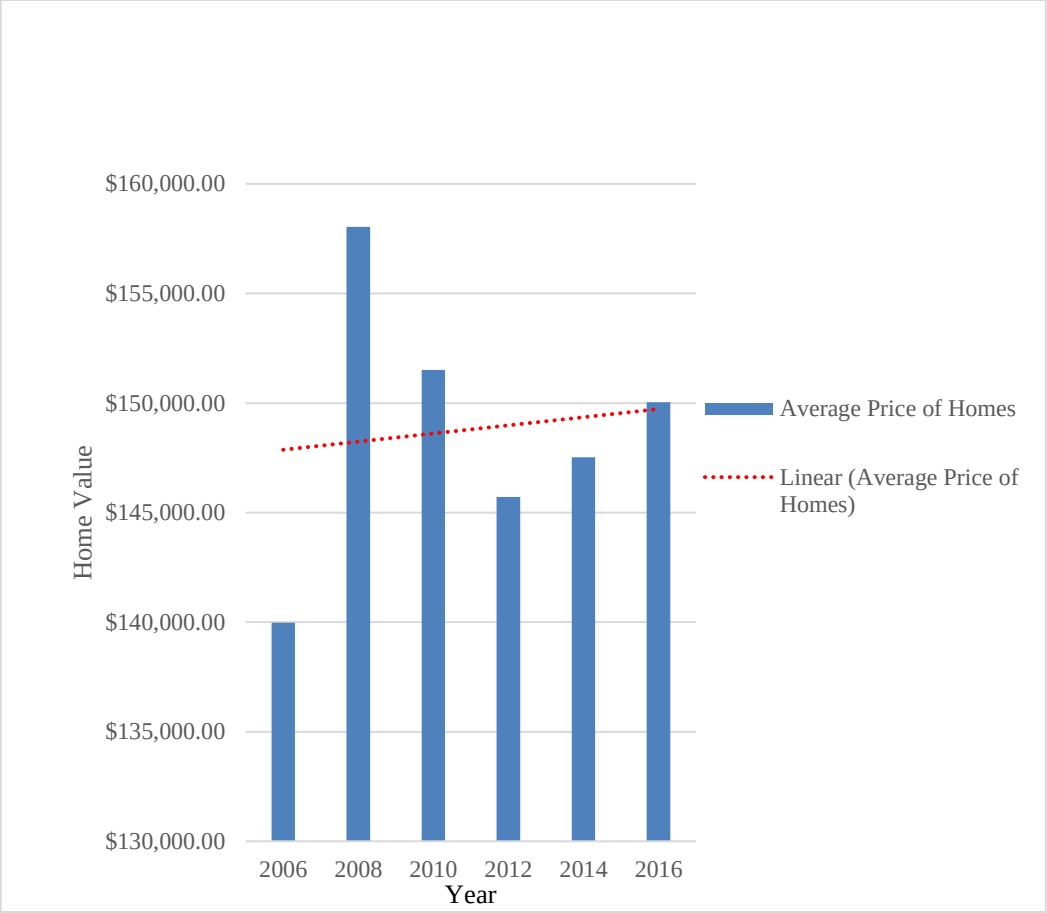

Figure 31-Average Housing Value for Sample Non-Hot Spot Area of Pueblo, Colorado

From the housing value analysis preformed on the hot spots it can be deduced that housing values decreased, and violent crimes increased. The results of both the hot spots and the home values provided that SDT is a theory that can be applied to Pueblo, CO when analyzing crime.

4.5 Summary Findings

This thesis set out to answer three questions about crime and housing value within Pueblo. These questions were: 1) have crime rates changed over time? 2) do the changes in crime rates have a spatial pattern? and 3) does the change in crime rates mirror housing values? The following will explain how these questions were answered.

Have crime rates changed over time in Pueblo? Yes, they have as viewed in Figure 14, there is an increase in crime from 2006 to 2016. Do the changes in crime rates have a spatial pattern? Yes, the crimes did show a spatial pattern, which can be viewed in Figures 18-24. And lastly, does the change in crime rates mirror housing values? This question is a bit harder to give a definite yes or no. Housing values that were sampled in both areas of crime hot spots and areas that were not hot spots for crime show volatility over the 2006-2016 time frame. There is not a direct trend of decreasing values year to year, for example for homes in the hot spot area during 2008 values increased, during 2008 violent crime also increase. However, the following years 2009-2016 did show decreases in value year to year subsequent to and in conjunction with an increase in the number of occurrences of violent crime, but also a leveling off of the housing values from 2014 to 2016. After taking this into account, the answer to question 3 is more difficult to answer and will be further explored in the next chapter.

Chapter 5: Discussion and Conclusion

5.1 Discussion

SDT is a theory that has been applied to the study of crime for quite some time. It has been tested through studies performed by Sampson and Groves (1989) as well as others such as Kubrin and Weitzer (2003) more recently. These studies have concluded that SES has some effect on crime rates. This thesis used the City of Pueblo, Colorado as a study area to apply SDT through the analysis of violent crime in conjunction with housing values for areas affected by violent crime to address three questions: 1) how have crime rates changed over time? 2) do the changes in crime rates have a spatial pattern? and 3) does the change in crime rates mirror housing values? This chapter will cover the conclusions that were found through the analysis and study of SDT in Pueblo when examining violent crime in relation to housing values (as an indicator of SES). Also, a section is devoted to future research and analysis, and lastly a section on closing thoughts from the author.

5.1.1 Hot Spot Analysis and Social Disorganization Theory Conclusions

This study found that areas experiencing higher incidents of violent crime, including Second-Degree Burglary, First-Degree Aggravated Motor Vehicle Theft, Second-Degree Aggravated Motor Vehicle Theft Value and Aggravated Robbery are also areas with lower housing values. Hot spots of these three crime types, on the Eastside and Central Southside, are mainly in PPD Quadrants 2 and 3. Additionally, the instances of these crimes increased over the study period of 2006-2016 and the housing values for these areas declined in the same time period. The decline of housing values for areas that show hot spots of violent crime contrast areas that are non-hot spots. The housing values in the sampled non-hot spot areas increased in

value over the eleven-year time span. Even though these housing values did see an initial decline in the years following the Great Recession (Figure 31), overall the trend shows an increase in value.

Social disorganization theory provided the foundational framework for this thesis through the use of socioeconomic status via housing values as an indicator of areas that would be considered low on the socioeconomic ladder (Coffee et al. 2018). SDT was determined to be the best criminological theory to use because of its history of using early GIS to help explain why crime happens. This theory was applied to Pueblo, Colorado and the findings add credence to the theory. When examining the housing values for the sampled hot spot areas, there is an overall decrease (Figure 30). This trend appears to follow the increase in violent crime in these areas (Figures 14). However, there is not enough evidence to parse out the causality and directionality of this relationship, and to affirmatively state that lower SES (as expressed through housing values) led to an in increase in violent crime in an area, or vice versa. There is a relationship between the two even if it is a simple location-based relationship, which had not previously been shown at this scale for Pueblo, Colorado.

Additionally, during this time there was a down turn in the economy (the 2008 recession), which could have had an effect on certain housing values with already lower price homes dropping in value faster and at relatively higher percentages than others. Overall, further study is needed to parse out the spatial influence of the 2008 recession, and lag time (if any) between the decreasing housing values and increasing violent crime occurrences. Therefore, it cannot be determined at this time whether low housing value had an effect on violent crime in Pueblo. Without further analysis, it cannot be fact that housing value and crime are causally connected and which is the driver.

5.2 Future Research and Analysis

This thesis explored data and analysis techniques that could be further utilized to test SDT and crime in the City of Pueblo. It is suggested that future research be done on all crimes in Pueblo, including non-violent and property crimes using the similar methodology that was used for this thesis, it should also be noted that in future research the crime counts in an area could be normalized by population. This normalization could be performed using United States Census Block groups as the level of spatial analysis. Using block groups would provide the tools needed to normalize the crime instances by population, providing a more detailed view of the rate of crime per capita. Additionally, a deeper examination of nonviolent crimes, including property crime, could be incorporated.

Given that the housing values had to be individually acquired, only sample areas were analyzed. Working with the assessor's office, one could possibly attain all necessary data by parcel thereby allowing for analysis on across all of Pueblo. Also, it is suggested that additional economic variables and demographic variables be added. This thesis used only housing values as an indicator of economic status, therefor the results were limited. This limitation can be avoided by showing that the areas that have high crime rates also exhibit other indicators of low SES. The demographics suggested include education, median household income and individual income, employment rates, incarceration rates, recidivism rates, and school attendance rates. These variables could be incorporated into a similar analysis determine if the violent crime hot spots are also hot spots for these variables.

Lastly, one other area of examination that would provide some insight into why Pueblo has a high violent crime rate would be to look at how the legalization of recreational marijuana has affected the violent and nonviolent crime instances. One could examine various community

structures such as access to after school programs, church attendance, and other social activities that are available for the youth and young adults throughout the community. These areas of study would all work well for the methodology used for this thesis and would add a benefit to the defense that social disorganization theory can be applied to Pueblo, CO. These topics would also have a positive impact on the community and how the police interact with the citizens.

5.3 Closing Thoughts

Pueblo, Colorado is a place that the author of this thesis calls home, so this project was very close to his heart. In an attempt to aid the city in looking at crime through a new lens he feels that more questions were created than answered. With that being said, he does feel that identifying the areas where violent crime has happened in the past can pave a path to identifying a solution to lowering these types of crime. Through future study in the areas that were mentioned in Section 5.2 the community of Pueblo could see a positive impact and be better able to design policy and ordinances to benefit the positive growth of the city and its population. It is the opinion of the author that if the City of Pueblo increased economic opportunity for its citizens through economic development and attracting higher paying jobs, there would be a drop-in crime rates.

Social disorganization theory helps to identify the problem of why crime happens, and it is a theory that city government and law enforcement can apply to the City of Pueblo. Applying this theory in conjunction with the variables mentioned above in Section 5.2, it may be possible to address the underlying reasons for the high crime rates in Pueblo and thus find a solution to lowering it permanently through economic and social development programs.

References

Ahmadi, Mostafa. 2003. "Crime Mapping and Spatial Analysis." Master's thesis., International Institute for Geo-Information Science and Earth Observation, Netherlands.

American Factfinder. 2017. [online] Factfinder.census.gov. Available at: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

Broadhead, Wade. 2019. [online] "History of Pueblo | Pueblo, Colorado." *Pueblo.org*. Available at: http://pueblo.org/History.

Buonanno, Paolo, Daniel Montolio, and Josep Maria Raya-Vílchez. 2012. "Housing Prices and Crime Perception." *Empirical Economics* 45 (1): 305-321.

Bureau of Justice Assistance 1994. *Understanding Community Policing: A Framework for Action*. Washington DC: Bureau of Justice Assistance Response Center. pg. 3.

Chainey, Spencer, Lisa Tompson, and Sebastian Uhlig. 2008. "The Utility of Hot Spot Mapping for Predicting Spatial Patterns of Crime." *Security Journal* 21 (12): 4-28.

City of Pueblo Police Department 2018. *2017 Motor Vehicle Theft Report*. Pueblo, Colorado: Pueblo Police Department.

Coffee, Neil T, Tony Lockwood, Peter Rossini, Theo Niyonsenga, and Stanley McGreal. 2018. "Composition and Context Drivers of Residential Property Location Value as a Socioeconomic Status Measure." *Environment and Planning B: Urban Analytics and City Science* (October).

Colorado Department of Public Safety. 2018. *Colorado Crime Statistics*. [online] Available at: https://coloradocrimestats.state.co.us/tops/.

Colorado Revised Statutes. 2019. [online] Available at: https://advance.lexis.com/container?config=0345494EJAA5ZjE0MDIyYy1kNzZkLTRkNzktYTkxMS04YmJhNjBlNWUwYzYKAFBvZENhdGFsb2e4CaPI4cak6laXLCWyLBO9&crid=7a1f2831-0023-4461-9ad3-e25e68ea3663

Coser, Lewis A. 1957. "Social Conflict and the Theory of Social Change." *The British Journal of Sociology* 8 (3): 197.

DeMeester, Deborah S., Donald R. LaMagdeleine, and Cari Norton. 2011. *The Rebirth of Community Policing: A Case Study of Success*. Minneapolis, MN: Columbia Heights Police Department.

Eck, John E., Spencer Chainey, James G. Cameron, Michael Leitner and Ronald E. Wilson. 2005. *Mapping Crime: Understanding Hot Spots*. Washington, DC: Office of Justice Programs National Institute of Justice.

Esri. 2018a. "Kernel Density." [online] Available at: https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/kernel-density.htm

--- 2018b. "How Hot Spot Analysis (Getis-Ord Gi*) Works." [online] Available at: https://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-hot-spot-analysis-getis-ord-gi-spatial-stati.htm

Ezez. 2019. "Overview - EVRAZ North America." *Evrazna.com*. http://evrazna.com/Company/Overview/tabid/57/Default.asp.

Federal Bureau of Investigation. 2018. *Uniform Crime Reporting (UCR) Program*. [online] Available at: https://www.fbi.gov/services/cjis/ucr.

Getis, Arthur, and Keith Ord. 1992. "The Analysis of Spatial Association by Use of Distance Statistics." *Geographical Analysis* 24 (3): 189-206.

Hickenlooper, John. 2018. *Pueblo Region | Colorado Office of Economic Development and International Trade*. [online] Available at: https://choosecolorado.com/regional-profile/pueblo-region/.

Hirschi, Travis. 1969. *Causes of Delinquency*. Berkley, CA: University of California Press.

Ihlanfeldt, Keith, and Tom Mayock. 2010. "Panel Data Estimates of the Effects of Different Types of Crime on Housing Prices." *Regional Science and Urban Economics* 40 (2-3): 161-172.

Jacober, Cpl. David. 2018. "Pueblo Policing." Corporal David Jacober Interview by Dane Cornell. In person. Pueblo Ice Arena.

Kornhauser, Ruth. 1978. *Social Sources of Delinquency: An Appraisal of Analytic Models*. Chicago, IL: University of Chicago Press.

Kubrin, Charis E., and Ronald Weitzer. 2003. "New Directions in Social Disorganization Theory." *Journal of Research in Crime and Delinquency* 40 (4): 374-402.

Markowitz, Fred E., Paul E. Bellair, Allen E. Liska, and Jianhong Liu. 2001. "Extending Social Disorganization Theory: Modeling the Relationships Between Cohesion, Disorder, and Fear" *Criminology* 39 (2): 293–319.

Markus, Ben. 2014. "Decades Later, Pueblo Still Reeling from Steel Exodus." *Colorado Public Radio* https://www.cpr.org/news/story/decades-later-pueblo-still-reeling-steel-exodus.

Mannheim, Karl. 1935. *Collected works of Karl Mannheim*. London, UK: Routledge.

National Criminal Justice Reference Service. Department of Justice. Office of Justice Programs. 2019. [online] Available at: https://www.ncjrs.gov/

Park, Robert E., and Ernest W. Burgess. 1925. *The City*. London, UK: The University of Chicago Press.

Rees, Jonathan H. 2017. "Colorado Fuel & Iron." *Colorado Encyclopedia* last modified December 28, 2017, http://coloradoencyclopedia.org/article/colorado-fuel-iron.

Sampson, Robert, and W. Byron Groves. 1989. “Community Structure and Crime: Testing Social-Disorganization theory.” *American Journal of Sociology* 94 (4): 774-802.

Sampson, Robert J., Jeffrey D Morenoff, and Thomas Gannon-Rowley. 2002. "Assessing “Neighborhood Effects: Social Processes and New Directions in Research." *Annual Review of Sociology* 28 (1): 443-478.

Silver, Eric. 2000. "Extending Social Disorganization Theory: A Multilevel Approach to the Study of Violence among Persons with Mental Illnesses" *Criminology* 38 (4): 1043-1074.

Shaw, Clifford R., and Henry D. McKay. 1969. *Juvenile Delinquency and Urban Areas*. Chicago, IL: University of Chicago Press.

Sutherland, Edwin. 1947. *Principles of Criminology*. Philadelphia, PA: J.P. Lippincott.

Suttles, Geraldo. 1968. *The Social Order of the Slum*. Chicago, IL: Univ. of Chicago Press.

United Nations Office on Drugs and Crime. 2010. *Monitoring the Impact of Economic Crisis on Crime*. Vienna, Austria: UNODC Statistics and Surveys Section.

United States Department of Labor. Bureau of Labor Statistics. *Colorado at a Glance.* 2018. [online] Available at: https://www.bls.gov/eag/eag.co.htm

US Legal, Inc. 2018. "Legal Definitions Legal Terms Dictionary | US Legal, Inc.” *Definitions.uslegal.com*. https://definitions.uslegal.com/.

Vernez Moudon, Anne, Andrea J. Cook, Jared Ulmer, Philip M. Hurvitz, and Adam Drewnowski. 2011. "A Neighborhood Wealth Metric for Use in Health Studies." *American Journal of Preventive Medicine* 41 (1): 88-97.

Walker, Samuel. 1999. *The Police in America.* 3d ed. Boston, MA: McGraw-Hill College.

Williams, Frank P., and Marilyn D. McShane. 2004. *Criminological theory*. 6th ed. Columbus, OH: Upper Saddle River.